THE CONSTELLATIONS
AS SEEN IN SOUTHERN INDIA.

Reprints from the Madras Times of Articles

BY THE LATE

R J POCOCK, B Sc, F R A S,

Director of the Nizamiah Observatory,

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THIS BOOK IS DEDICATED TO

THE AUTHOR'S

TWO BABY DAUGHTERS,

ELLEN DOROTHY AND ROBERTA JOAN

PREFACE

Robert Pocock's work at the Nizamiah Observatory is known and valued by astronomers To the public in India he is perhaps chiefly known by his Star Chart for India, which will form a useful companion to this book Had he lived he intended to revise his weekly "Astronomical Notes" written for the Madras Times in 1916 to 1918, and publish them in book form The constellation notes were especially popular, for although there are simple guides to the constellations for both northern and southern countries, suitable to the latitudes of London and Sydney respectively, there is none for the tropics.

The following pages apply chiefly to the Madras Presidency, and all places in about the same latitude, but the book may also be used throughout India, if it is remembered that as one goes north one loses something of the southern constellations, so that they do not rise so high above one's horizon, and are not seen for so long a time

The articles are grouped under the months to which they are appropriate, from January to December, as intended by the author they begin with the striking and well known constellation Orion, and include all the bright or important groups of the heavens, for in South India besides seeing all the constellations of the northern hemisphere, we are able to see all the southern hemisphere also, except a small part round the south pole which contains hardly any bright stars, As the author was unable to revise it himself, the original has been closely followed, only such omissions and re-arrangements being made as seemed necessary to adapt the weekly notes to a book for permanent use

It is thought that readers may like to learn something about the author's work on the stars at Hyderabad, and therefore one of his articles on this subject has been added at the end of the book

The Madras Mail, with which the Madras Times is now amalgamated, has kindly permitted the use of the original blocks made for the star-maps which accompanied the weekly notes

My grateful thanks are due to Mrs Evershed for her invaluable help in compiling this little book to my dear husband's memory

AUGUST, 1921 ELLEN POCOCK.

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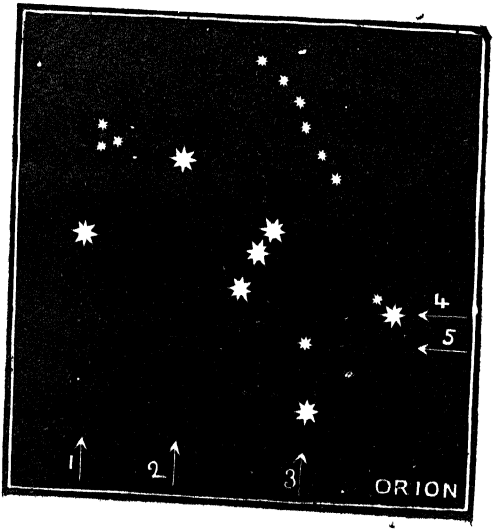
JANUARY.

ORION.

Probably most watchers of the sky would agree that Orion is the finest constellation in the whole sky It is remarkable as well for its large size and the brilliance of its stars as for the number of interesting objects which it contains

It will be found early in the evening at this time of year, well up in the sky, somewhat south of east, and it may be readily recognized by the four bright stars forming a large trapezium with a line of three bright stars within. The constellation is figured below.



ORION.

The constellation lies just outside the Milky Way, and so shows up clearly against a dark background It is mentioned several times in the Old Testament, in the books of Job, Amos, and Ezekiel, and one could fill a whole column with poetical quotations relating to Orion

Stars 1 and 2 mark the shoulders of Orion, while 3 and 4 mark his feet, his right arm is outstretched holding a club, while his left is enveloped in the lion's hide, the outline of which is marked by the curved line of six small stars at the upper right-hand part of the above map His girdle or belt is marked by the three bright stars in the centre, and from this belt hangs his sword, marked by three lesser stars, of which only one is shown.

The bright red star Aldebaran lies above the constellation.

The star marked 1 is ruddy in colour and is called Betelgeuse from the Arabic Ibt-al jauza, meaning the shoulder of the giant This is a variable star, though the variation is not very great at its brightest it is the twelfth brightest star in the sky, and is slightly brighter than Aldebaran; at its faintest it is not so bright as Aldebaran; the variation is irregular.

This star is at almost exactly the same distance from the earth as another bright red star Arcturus, now invisible in the early evening In each case light takes 126 years in its journey to the earth. If Betelgeuse were at the same distance from the earth as the sun, it would appear 800 times as bright as the sun.

No. 2 is called Bellatrix, or the female warrior

No 4 is called Rigel and is the seventh brightest star in the sky The name is derived from the Arabic Rijl-al-jauza, the giant's leg This star is white, but it has a faint companion which is blue in colour

Of the stars in the belt, the one at the top of the map is a wide double This star is sometimes called Mintaka, from Mintaka al jauza, the giant's belt, while the star at the lower end is also a double, but a close one The smaller star is of a peculiar colour which has been described as greenish red Close to this star is another fairly bright star which a small telescope will show to be double, but a large telescope shows that each star of the pair really consists of three, with two stars between them, while the very largest telescopes show that the brightest of these eight stars is composed of two stars exceedingly close together, and yet this is not all, for connected with this latter pair is yet another star which has been revealed by the spectroscope, so that what looks to the unaided eye as a single star consists in reality of at least ten stars, a sort of replica of the solar system

Of the group of three stars shown above Nos 1 and 2, one is a double, while another is moving with a velocity of over 60 miles a second There are other double stars in this constellation

I have only shown one star of the line of small stars which form Orion's sword, in order not to confuse the figure. This one star is marked 5 in the map This appears to the naked eye as a wide double, one star appearing hazy to the naked eye, the other is itself double, but it is to the hazy one that I wish to call special attention.

With a small telescope this appears not as one but as four stars, forming a trapezium. Although these stars have been observed for 250 years, they show no evidence of change, their relative positions remain exactly the same. Two other stars were found in the group in 1826 and 1830 respectively, and more recently by means of the great telescope at the Lick Observatory in America three more stars have been added to the group, one of them a very faint and close double star. Moreover the leading star of this group is a spectroscopic binary, that is, a double star too close to be seen as such with any telescope, and only revealed by the spectroscope.

The reason why this group looked at with the naked eye appears hazy is because it is intimately associated with the great Orion nebula, one of the finest and most wonderful of the irregular nebulae. This nebula is easily visible in a small telescope, though its true proportions can only be seen in a photograph taken with a large telescope and a long exposure.

The nebula consists of a mass of glowing gas of an irregular shape, somewhat resembling the mouth of a fish.

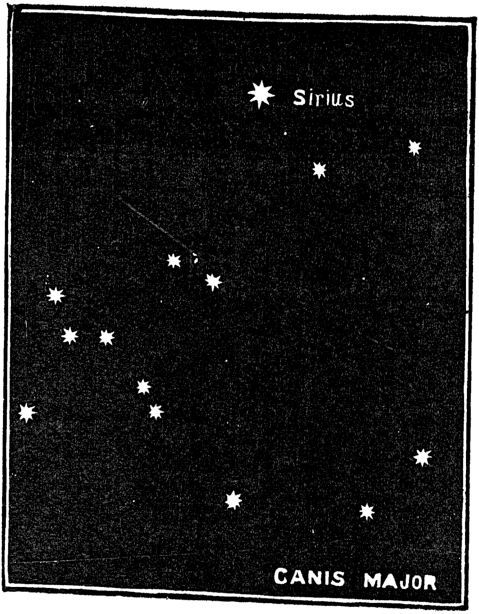
It has glowed for centuries without any apparent diminution in light Its distance has hitherto proved immeasurable, and it must be enormous Just think then of the vast extent and brightness which this nebula must have in order to render it visible to the naked eye, though placed so far distant that hitherto all man's efforts to gauge the intervening space have proved in vain!

CANIS MAJOR—THE GREAT DOG.

One of the features of Orion, as we have just seen, is the straight row of three bright stars forming Orion's belt These three stars point downwards to the brightest star in the sky, Sirius the Dogstar, the principal star in Canis major, the Greater Dog

Once you have identified Orion's belt, therefore, you should have no difficulty in finding this constellation, which early in the evening at the beginning of January is low down in the southeast The other dog, Canis Minor, is not far away The constellations Canis major and Canis minor represent the two hunting dogs of the great hunter Orion Each of them contains one conspicuously bright star,—Sirius the Dogstar in one case, and Procyon the Fore dog in the other The Greater Dog—as indeed should be the case—is much the larger of the two, and Sirius is considerably brighter than Procyon

The constellation **Canis** major is figured below.



CANIS MAJOR—THE GREAT DOG

I have figured this constellation on a rather larger scale than usual . it is not in reality a very large one

By far the most interesting object in the constellation is Sirius Only two stars are known to be nearer to us than Sirius, the light from which takes the comparatively short time of eight and a half years to reach us The star is travelling through space at a rate of about twelve miles a second, Sirius is a glorious sight when viewed through a large telescope, especially if put slightly out of focus Some people even seem to think this one of the most beautiful sights revealed by the telescope The great astronomer Sir William Herschel says that when he turned his large four-foot mirror on this star, the light was like that of the rising sun, and it was impossible to look at the star without pain to the eye.

Sirius is a bluish white star, but it seems probable that it has changed its colour within historic times, since some 2,000 years ago Ptolemy classed it as a red star with Aldebaran, Antares, and other ruddy-hued stars

Many years ago in 1844, observations of this star showed that it was moving in what at first appeared quite an irregular manner Further observation and study, however, brought order out of chaos, and it appeared that the movements could be easily accounted for on the supposition that Sirius was really a double star, and that besides the bright star which we can see, there existed another star which we could not see, around which the bright star was moving.

This second star was firmly believed in for several years by astronomers, and eventually in 1862 when more powerful telescopes came to be constructed, the star was actually seen just as had been predicted as the result of calculations.

The second star is a very faint star of a yellowish hue, and when it is stated that Sirius itself is four thousand times as bright as its faint companion, it will readily be understood why it was many years before it was seen Such a star alone in the sky would not be difficult to locate, but lost in the light of blazing Sirius, very keen perception is needed to make it out

But although Sirius is so much brighter, it is only twice the weight of its companion Since Sirius is also about twice as heavy as the sun, the companion to Sirius is about the same weight as the sun, but it gives far less light.

These two stars appear very close together even in the largest telescope, but this is an effect of distance, and their distance is in reality very great, about twenty times the distance separating the earth from the sun, or close on two thousand million miles! Sirius takes about half a century to complete its gigantic orbit around its companion

Sirius, as the brightest star in the sky, naturally attracted the attention of primitive peoples, and figures often in ancient lore and legend By the Egyptians Sirius was an object of worship, and they commenced their year on the day on which Sirius rose just before the sun Sirius was also worshipped by the ancient Arabs, and is mentioned in the Koran At the Feast of the Floralia it was the custom to sacrifice red dogs to the Dog Star (a further indication that at one time Sirius was of a distinctly reddish hue)

Among many ancient and mediaeval peoples the Dog Star was an ill-omened star, bringing with it evil influences, and as far back as the time of the ancient Greeks we find Homer writing of this star as one

"whose burning breath
"Taints the red air with fevers, plagues, and death."

Perhaps here again the idea of burning breath is suggested by the reddish colour of the star The fact of this almost certain change of colour in the star is of considerable interest, since the number of cases in which we know for certain that a star has changed colour within historic times is very small, and it lends further interest to this brightest and one of the most interesting of the stars of heaven

Even in early times people realised the possibility of this star being in reality brighter than our own sun. Thus Manilius wrote

> "'Tis strongly credited this owns a light
> And runs a course not than the sun's less bright,
> But that, removed from sight so great a way,
> It seems to cast a dim and weaker ray"

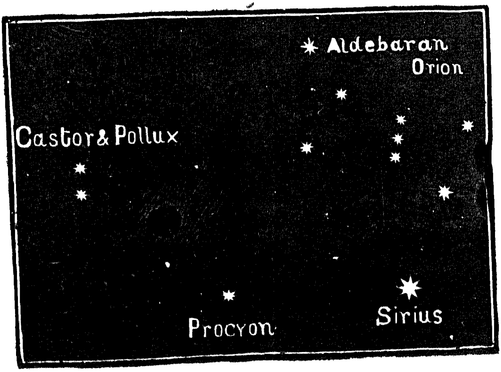
As a matter of fact the above lines are perfectly true The star is in reality 48 times as bright as the sun, but owing to its much greater distance "it seems to cast a dim and weaker ray"

Just south of Sirius is a fine star cluster which is just visible to the naked eye to those who are favoured with good eyesight, and an interesting object for those who have small telescopes

CANIS MINOR—THE LESSER DOG

The constellation of Canis minor is very small, and would be quite insignificant were it not for its principal star, Procyon the fore dog.

I give below a diagram which should help you to find Procyon if you look east in the early evening in January



PART OF THE EASTERN SKY IN JANUARY.

If you look east you will see high up the great constellation Orion with its trapezium of four bright stars and the three stars forming the belt in the centre These three stars point down to Sirius, as we have seen To the left of Sirius is Procyon, the chief star of Canis major, and further to the left and higher up are two bright stars, Castor and Pollux.

The space between Canis major and Canis minor, or roughly speaking between Sirius and Procyon, is occupied by Monoceros, the Unicorn, and is quite devoid of bright stars.

Procyon is so called (meaning the fore dog) because it is seen as a morning star earlier than Sirius, the Arabic name meant much the same, but was considerably longer, ***viz.*** Al-kelb-al-mutekaddem Procyon like Sirius was supposed to be a star of evil omen. "What meteoroscoper" said a certain astrologer, "yea, who that is learned in matters astronomical, noteth not the great effects at the rising of the star called the Litel Dogge?"

Besides this supposed resemblance, there are other real resemblances

Procyon is the eighth brightest star in the sky. It is not quite so bright as Rigel in Orion. The star is a little further away than Sirius, but is still one of the ten nearest stars known to us Procyon is both really and apparently somewhat less bright than Sirius, its actual brightness being about one-fifth that of Sirius Like Sirius, Procyon is a double star, and as in the case of Sirius the companion to Procyon is extremely faint, and was actually known to exist from theoretical considerations long before anyone ever saw it. Indeed whereas the companion to Sirius was first seen in 1862, it was not till 1896 that the companion to Procyon was first seen This companion, although it is about three-fifths as heavy as the sun, is far less luminous. It would take twenty thousand such stars at the same distance as the sun to give us the same amount of light as we receive from the sun. This small star moves round Procyon once in forty years.

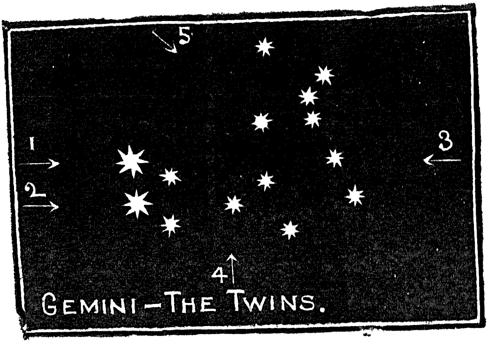
Just as in the case with Sirius and his companion, there is a great difference in luminosity between Procyon and his companion, Procyon outshining the other nearly 5,000 times, and yet Procyon is only seven times as heavy as his companion. Sirius, as we saw, outshines his companion over 4,000 times and is only twice as heavy.

The light from Procyon takes about ten years to reach the earth, a very short time to spend on the way compared with the time taken by light to travel from most of the stars

Procyon is also a fairly rapid traveller through space, as is so often the case with double stars, but it cannot be classed among the most rapid stars known.

GEMINI—THE TWINS

To the left of Procyon and higher up you will see two bright stars close together These are Castor and Pollux, the bright twin stars of Gemini, which is a large constellation and one of the signs of the zodiac Having located these two stars, the other stars of the constellation may be found by means of the map below.



GEMINI—THE TWINS

In the above map Nos 1 and 2 are Castor and Pollux respectively. They are named after the two gods who came and fought for Rome in the battle of Lake Regillus (Students of Macaulay's Lays of Ancient Rome will remember all about this) It will also be remembered that St Paul travelled by a ship named after these same two gods

Castor is a very fine double star, and when it is available it is usually the one chosen by astronomers for exhibition to visitors to show them what a double star looks like Both the stars are very bright, and they form a true binary system, though their period of revolution is several centuries in length They can be seen as a pair with quite a moderate telescope, and the sight of these two brilliant orbs in such close juxtaposition is very fine indeed Both the stars are of the same colour, white, and at some distance from them is a tenth magnitude star which probably also belongs to the system. But each of the bright stars has associated with it a dark star, round which it revolves. Each of them thus forms what is known as a spectroscopic binary, the duplicity being invisible in an ordinary telescope and only discoverable by means of the spectroscope The whole system thus consists of five stars, the two bright ones, their two dark companions, and the faint star above mentioned Light takes about 65 years to travel from Castor to the earth, so that it is not such a very distant star It is the twenty-second brightest star in the sky

Pollux is about the fifteenth brightest star in the sky, and is at just about the same distance from the earth as Castor It is a fairly rapidly moving star, moving through space with a velocity of some thirty or forty miles an hour.

Three other stars in this constellation have names, ***viz.***, those marked 3, 4, and 5 in the map No 3 is called Alhena, and No 4 is named Wasat from the Arabic Al-wasat, which means the middle or centre This star is a double, its companion being a faint purple star which can just be seen with a small telescope if it is a good one The star marked 5 is called Mebsuta

Above the star marked 3 and just to the right of No 5 in the map will be seen three stars close together Just above these is a very fine cluster of stars, not quite visible to the naked eye, but easily visible in a small telescope.

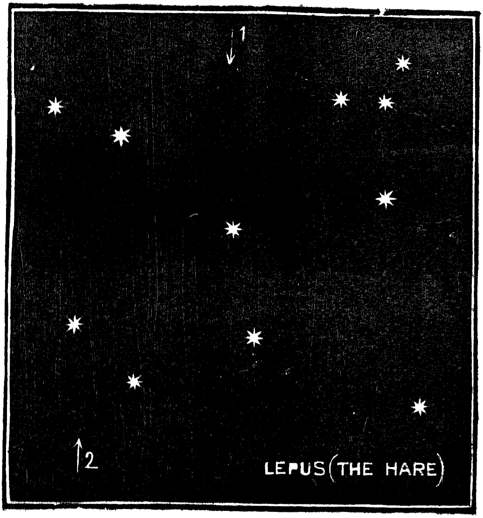
There are several other double and variable stars in this constellation

FEBRUARY.

LEPUS—THE HARE

Below Orion and to the right of Sirius is the small constellation Lepus, the Hare Lepus is one of the ancient forty-eight constellations, and although it contains no one star of outshining lustre, it contains a number of quite conspicuously bright stars, and should be easily identified in the sky once the surrounding constellations are known

The important stars of this constellation are shown in the map below.



LEPUS—THE HARE.

The star marked 1 is the brightest star in the constellation and is called Arneb, from the Arabic Al-arneb, the hare. The star marked 2 is in very rapid motion and is moving away from the earth at the rate of about sixty miles a second

Of this constellation an ancient writer (Aratus) wrote in 300 B.C —

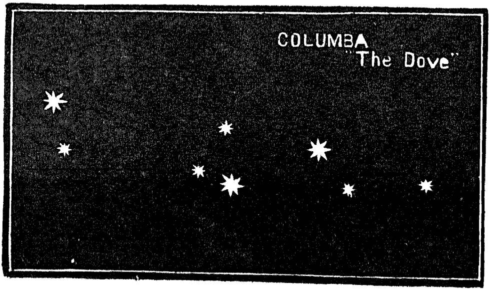
> "And ceaselessly beneath Orion's feet
> The Hare is ever chased."

The four principal stars of this constellation were called by the Arabs "the throne of the giant," the giant of course being Orion

COLUMBA—THE DOVE

Below Lepus is the small constellation Columba the Dove, sometimes called Columba Noachi, Noah's Dove. This is a small but well-marked constellation, in a region not very thickly sown with stars It is not one of the ancient constellations, having only originated in 1679, thanks to Roger, who thought that since the constellation Corvus the Crow was supposed to represent Noah's raven, it was only fair that his dove should also figure among the constellations.

I have figured below the brightest stars of this constellation. Only four or five are readily visible to the naked eye.



COLUMBA—THE DOVE.

Below Columba are a number of minor (modern) constellations. Caelum, Pictor, Dorado, etc

A word about the origin of constellations may not be inappropriate here

Anyone looking at the heavens on a clear moonless night would realize that to find individual names for all the stars visible to the naked eye would be a gigantic task The early astronomers seemed to realize this and to have contented themselves with giving names only to the brightest stars. Some of the names are still in common use, but many of them are seldom or never used by astronomers.

The great mass of the stars the ancients divided into groups, known as constellations, which they named after some animal or mythical hero, probably in most cases seeing some fanciful resemblance in the shape of the constellation to the animal after which it was named. In this way forty-eight constellations were known to the ancients which included all the principal stars visible from Southern Europe. In the middle ages many more constellations were added, some of them so small and inconspicuous that they have long since dropped out of use, others, notably those surrounding the South Pole, which were not visible to the early watchers of the skies whose records have come down to us, have remained in common use till the present day. But except for the southern constellations, nearly all the most important are contained among the ancient forty-eight

These forty-eight include the twelve zodiacal constellations or signs of the Zodiac, through which the sun passes in the course of his yearly journey round the earth (of course in reality the earth moves round the sun, but relatively to the stars the sun appears to move round the earth once a year, and the ancients considered that it actually did do so).

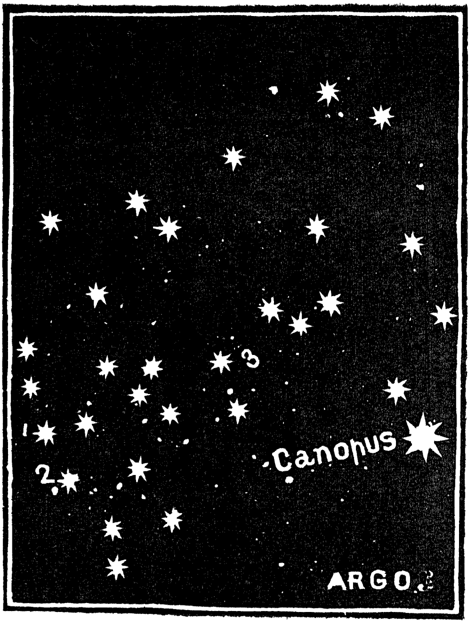
The actual date of the first sub-division of the skies into constellations is lost in antiquity The ancient forty-eight constellations are all recorded in Ptolemy's Catalogue which is 2,000 years old, but they must date back much further than this They probably owe their origin to the ancient Chaldeans or Egyptians, though they may be even older. There is scarcely a nation in whose ancient annals or traditions we do not find some reference to the signs of the Zodiac. In the Chinese annals in the year 2357 B C, we read that the

Emperor divided the twelve signs of the Zodiac into the twenty-eight mansions of the moon (that is to say divided the signs of the Zodiac into 28 sub-divisions, corresponding to the 28 days of the lunar month) In these ancient days the constellation Draco, the Dragon, was the polar constellation, a star in this constellation occupying the pole of the heavens, about which all the other stars turned, and it may well be that it was from this constellation that the Chinese, who thought they occupied the centre of the world, adopted as their national emblem the Dragon

THE SHIP ARGO.

Away to the left of Columba and somewhat lower down is the constellation Argo, representing the good ship in which Jason and his band sailed to seek the Golden Fleece This is a very large and important constellation, though unfortunately always near the horizon in these latitudes So large is it that it is often divided into four separate constellations, representing the different parts of the ship, *viz*, Puppis, the Poop, Vela, the Sails, Malus, the Mast, Carina, the Keel

Early in the evening at this time of year, you will notice, low down in the southern sky, a conspicuously bright star: this is Canopus, the principal star of the constellation Argo (or of the sub-constellation Carina), and is the second brightest star in the sky, yielding pride of place only to the Dog-Star Sirius, The principal stars of this constellation are figured below.



ARGO

As a rule, the very bright stars are not very distant. This is obvious, for the farther away a star is the fainter it appears and, therefore, however intrinsically bright a star may be, if it is not also fairly close it will not appear among the brightest gems of heaven Canopus, however, is an exception to this rule, for it is a very distant star, so far away that hitherto all attempts to measure its distance have proved futile Since in spite of this great distance it appears so bright, we are bound to conclude that its intrinsic brilliance must be enormous It cannot be less than 20,000 times as bright as our sun, and its mass is probably great in proportion to its luminosity

In Southern India, Canopus is called Agastya, after a Brahman rishi who led an early Aryan colony to the south, and before whom the Vindhya mountains are said to have prostrated themselves as he passed

This large constellation contains a great many objects of interest The stars marked 2 and 3 are both centres of groups of bright stars worth examining with binoculars, while there are several clusters and nebulæ lying in this constellation The key-hole nebula which is associated with the star marked 1, is just visible to the naked eye on a clear moonless night The constellation also contains numerous double stars and variable stars, including quite a number of eclipsing binaries

The star marked 1 which, as already remarked, is associated with the key-hole nebula, is a most extraordinary star—one of the puzzles of the stellar universe. It is a slightly reddish star, and if you look for it with the naked eye you will not be able to see it, for at present it is between the seventh and eighth magnitude and, therefore, requires a telescope to render it visible

Nevertheless this has not always been the case. The history of the star for the past two thousand years is briefly as follows '—In the catalogue of stars which is contained in the famous Greek astronomical work compiled by Ptolemy nearly 2000 years ago and known as the Almagest, this star is not found, and from this we can fairly safely conclude that at that time it was invisible to the naked eye, and since that was long before the invention of the telescope, it was naturally therefore unknown to Ptolemy, and hence omitted from his catalogue.

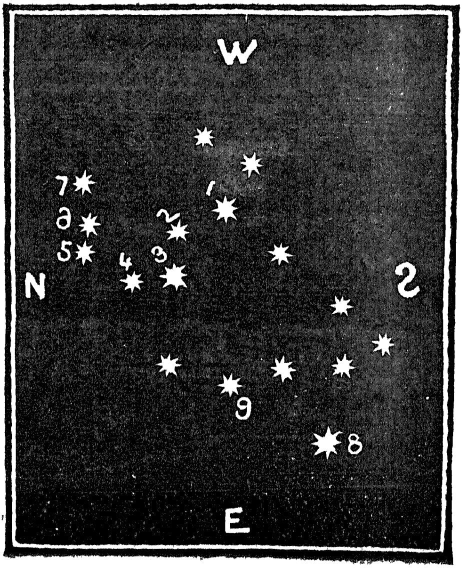
This star, like Canopus, cannot be seen from England, and since most of the records of astronomy which we have in the mediæval ages come from England or northern Europe, we know little of this star till 1677, when it was observed by Halley (of Halley's Comet fame) at St Helena It was then of the fourth magnitude and visible to the naked eye Eight years later it had much increased in brightness, and in the middle of the eighteenth century it was of the second magnitude In 1811 it was again of the fourth magnitude, and eleven years later had risen again to the second magnitude In 1826 it was still of second magnitude rank In 1827 it increased in brightness In 1832 it was again of second magnitude, and in 1837 it suddenly grew very bright, attaining for a time first magnitude rank It continued to vary thus until in 1843 it achieved its record brightness. During this year Eta Argûs, as the star is technically termed, was brighter than its brilliant neighbour Canopus, and only slightly inferior to Sirius For some ten years the star remained very bright and of a deep red colour, but by 1858 it had declined again to the second magnitude. It continued to decline gradually until by 1868 it was invisible without telescopic aid, and by 1886 it had reached its present magnitude, rather below the seventh magnitude. For the past thirty years it has remained thus without any sign of the slightest variation

Such is the history of this amazing star Will it ever repeat its performance ? Shall we one day see again a rival to Canopus in the constellation Argo ? What was the cause of these tremendous and apparently quite erratic changes in this star ? These are some of the questions that we naturally ask about Eta Argūs At present it must be admitted that astronomers cannot give any certain answer. Eta Argūs remains a celestial puzzle.

MARCH.

LEO—THE LION

At this time of the year the western sky is much more conspicuous than the eastern sky in the evening The eastern sky in fact at this time only contains three specially bright stars, and of these the two brightest are close to the horizon Low down is the bright golden coloured star Arcturus, the principal star of Bootes, the Herdsman At very nearly the same level is Spica, the brightest star in Virgo, the Virgin. Higher up is the large zodiacal constellation, Leo, containing one bright star, Regulus The constellation is figured below.



LEO—THE LION.

The stars numbered 1, 2, 3, 4, 5, 6 and 7, form what is often called "The Sickle in Leo," the likeness of this group to a sickle is at once apparent

No 1 is Regulus, the brightest star in the constellation, and the twentieth brightest star in the sky It is sometimes called Cor Leonis, which means the Lion's Heart

Regulus was called by the Greeks Basiliskos, because it was supposed to be the king of the sky, and from this comes its present name of Regulus, which means much the same in Latin Regulus is a double star, the faint companion being of an indigo colour, and being itself a very close double requiring a powerful telescope to show it as such The distance of Regulus from the solar system is such that light travelling at the rate of 186,000 miles a second, takes very nearly 150 years to traverse the distance intervening between Regulus and the earth.

The star marked 8 is the second brightest star in the constellation and is named Deneb or Denebola, from the Arabian Dhanab-al-asad, which means the Lion's tail There are no less than three stars in the sky to which the name Deneb is at times applied The brightest star in Cygnus, the Swan, is called Deneb or sometimes Arided, while a star in Capricornus also owns this name, though the name is now usually confined to the bright star in Cygnus.

The star marked 3 is called Algieba, from Aljebbah, which means the forehead. It is a very fine double star, both the components are bright, and both are golden yellow in colour. Owing to their brightness and to their close proximity to one another, they require a fairly good telescope to separate them

The star marked 9 is called Zosma from the Greek for a tunic or girdle.

You will have noticed that nearly all the names of stars are derived from the Arabic, but that occasionally we find a star whose name is derived from Latin, and more rarely a star name is derived from the Greek This constellation contains examples of all three, the names Algieba and Deneb being of Arabic origin, Regulus from the Latin, and Zosma from the Greek. It should be understood that many of the star names given in this book have now almost dropped out of use among astronomers, who designate the stars by Greek letters, or by their numbers in some well-known catalogue—only a few of the brightest stars being commonly referred to by name, such as Regulus, Arcturus, Sirius, Castor and Pollux, Polaris (the Polestar), etc. Probably there are many astronomers who could not say offhand which stars in the sky owned the names Algieba or Zosma Amateur observers of the heavens, however, often like to know the old star names, and the meaning of these names is often instructive, giving a clue to the ancient figures of the constellation thus when we find that the Arabic name of a star means the Lion's tail, we know that this star formed the tail in ancient figures of the constellation

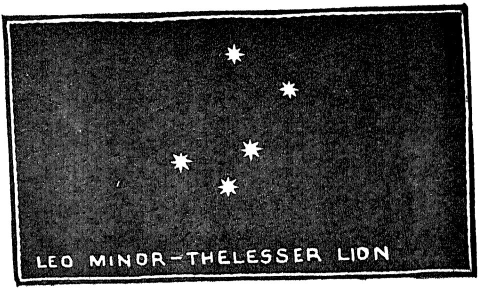
The stars forming the sickle formed the head and mane of the Lion

The well known stream of meteors which is conspicuous every year in November, and which provided magnificent meteoric displays in November 1799, 1833 and 1866, but was disappointing in 1899, appears to come from a point in this constellation, and hence the meteors are known as Leonids.

LEO MINOR—THE LESSER LION.

Looking away from Leo to the left and nearer the Pole, you will see Ursa Major, the Great Bear, in the north-east. This latter constellation is probably well-known to most readers.

Between the Lion and the Great Bear is a small and inconspicuous constellation known as Leo Minor or the Lesser Lion whereas the Lion is one of the old zodiacal constellations, the Lesser Lion only dates back to 1690. This small constellation is figured below as an aid to identification, but there is nothing of great interest to tell of it.



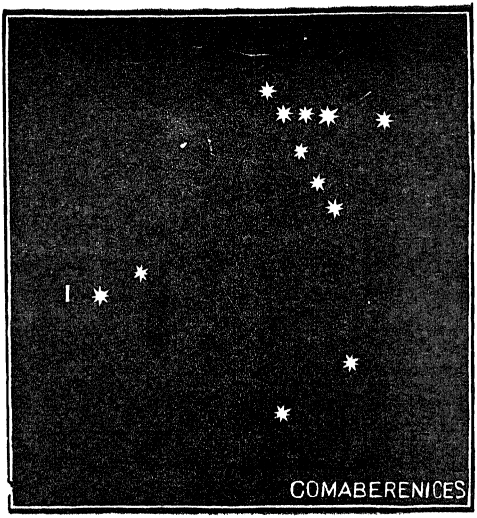
LEO MINOR—THE LESSER LION

There are two pairs of bright stars at the western end of the Great Bear The uppermost star in the above illustration is almost on the line joining these two pairs.

There is a small star in this constellation of between the fifth and sixth magnitudes (not shown in the map), which is moving at the rate of thirty miles a second, and which is comparatively close to the earth, its distance being such that light takes about forty-five years to travel from the star to our earth. It is thus about five times as far away from us as the brightest star in the sky, *viz*, the Dog Star, Sirius

COMA BERENICES—THE HAIR OF BERENICE.

Between Arcturus and Leo there are no bright stars, but a large group of stars, looking something like the Pleiades on a much larger scale, will be found occupying this space This large cluster of stars forms the constellation known as Coma Berenices, the Hair of Berenice I have figured it below.



COMA BERENICES—THE HAIR OF BERENICE.

This is not one of the ancient forty-eight constellations, and was generally regarded as a part of Leo, the Lion It was sometimes called Al-dafirah, the Tresses It was actually given its present name by Tycho Brahe, the great Danish astronomer, in 1601, though there is an unfounded legend which states that Conon first named the constellation The manner in which Berenice's hair is supposed to have got among the constellations is as follows —

Ptolemy Euergetes was at war, and his wife Berenice vowed that if he was victorious she would offer her hair to the goddess Venus When therefore Ptolemy had secured victory and returned to his wife, he found her head shorn of its beautiful tresses As this pained him considerably, the priests and astronomers were sent for to comfort him, and they very ingeniously discovered that Berenice's hair had been placed among the stars, which no doubt was a great consolation to Ptolemy!

The only individual star of any particular interest is that marked 1 in the figure It is one of the stars which is comparatively near to us, being about the same distance away as the bright star Aldebaran in Taurus, the principal star of the Hyades cluster It takes about thirty years for the light from this star to reach the earth! Also it is travelling through space at the rate of about thirty miles a second.

This constellation, Coma Berenices, is probably in reality a cluster of stars in space very similar to the Pleiades, and not merely a number of stars whose distances vary widely, but which are seen together in space owing to the fact that they all lie in the same direction. This group is much more scattered than the Pleiades, and therefore does not present quite such a striking sight, but except that it is more scattered there is an obvious similarity between the two groups.

The constellation contains a very large number of nebulæ —a characteristic shared by the neighbouring constellation Virgo.

CANES VENATICI—THE HUNTING DOGS

To the left of Coma Berenices, and a little higher up, just below the southern part of Ursa Major is the small constellation Canes Venatici, the Hunting Dogs It contains only two bright stars, one above the other, the brighter star being below the other when the constellation is in the east, as it is in early evenings at this time of the year

This also is one of the modern constellations, inserted in the sky by Hevelius It contains a very fine nebula known as the whirlpool nebula I quote the following description of this fine object —

"The nebula displayed itself as composed of a pair of curving arms issuing from opposite extremities of an oval central body. One of these loses itself in a vague effusion, as a comet's tail dies out into darkness. The other attains the secondary nucleus and there terminates"

The brightest star in this constellation, which, as already stated, is the lower of the two stars which are readily visible to the naked eye, is a star of the second magnitude, and is a very fine double, the two components being white and pale lilac in colour and visible in a small telescope—the brighter star of the pair being nearly forty times as bright as its companion This star is named Cor Caroli, which is Latin for Charles's Heart—the Charles referred to being King Charles II of England

The following is the story of how this star came by its name —

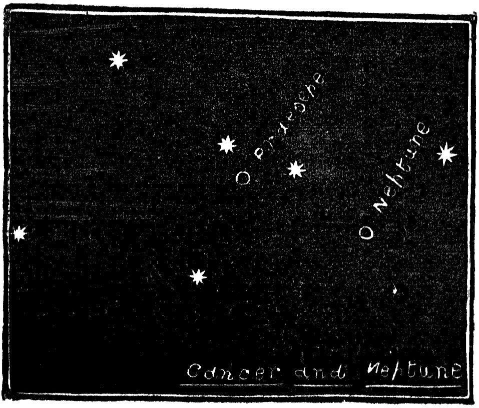
The night before King Charles II returned to London, Sir C Scarborough, the Court Physician of the time, happened to look at this star, the brightest in Hevelius' constellation of the Hunting Dogs, or the greyhounds Chara and Asterion, this star being supposed to denote Chara's collar On this occasion Scarborough happened to note that this star was brighter than usual, which may have been due to a temporary brightening of the star, or may have been due to an unusually clear atmosphere, or was quite possibly due to the imagination of the Court Physician At any rate, Sir C Scarborough attributed the fact to the star's loyalty to the king, considering that its unusual brightness was assumed in honour of the king's return to London He therefore persuaded Halley, the famous astronomer after whom Halley's comet is named, to form this star into a sort of constellation all by itself—the star being figured as surrounded by a heart surmounted by a royal crown, "and so," as one chronicler puts it, "the monarch, it would seem, by this extraction, remained heartless."

The star, however, retains its original place as the lucida (or bright star) of Canes Venatici, but it also retains its name of Cor Caroli—Charles's Heart.

In modern pictures of the constellation Bootes, the Herdsman, which lies further east, he is represented as holding the leash of the Hunting Dogs in his hand, though this cannot have been the original representation of Bootes, since the Hunting Dogs are a modern innovation.

CANCER—THE CRAB

Between Leo and Gemini lies Cancer—the Crab—the smallest and least conspicuous of all the zodiacal constellations. It is a very ancient constellation, and is important mainly from its position in the zodiac—the fourth of the signs.



CANCER—THE CRAB.

The six brightest stars are figured above.

The most conspicuous object in this constellation is the Praesepe or Beehive cluster, which I have marked in the map.

Dante, alluding to its faintness and high position in the heavens, wrote in the "Paradise" (Longfellow's tr) —

"Thereafterward, a light among them brightened,
So that, if Cancer one such crystal had,
Winter would have a month of one sole day."

Cancer's principal stars, none of which are brighter than the fourth magnitude, form an inverted "Y." A pair of the stars, Gamma and Delta, have been known from time immemorial as the "twin asses," or the "Aselli" Gamma, or the Asellus Borealis, and Delta or the Asellus Australis, stand, respectively, north and south of their manger, the cluster of small stars called "Praesepe." Delta—the Southern Asellus—a delicate double star, is situated in the line of the ecliptic

The historic cluster Praesepe, the "Beehive" or the celestial weather-glass, in the breast of the sprawling crab, about ten degrees south of Pollux, lies nearly between the "Aselli" a little to the west and, on very clear nights when the moon is absent, is visible to the naked eye as a little faint cloud, which a large opera-glass or a small telescope will easily resolve into an aggregation of small stars. It is of about the same size as the Pleiades and is composed of three hundred and sixty-three stars. It has often been mistaken by amateur observers for a comet.

"Like a little mist,
Far north in Cancer's territory, it floats,
Its confines are two faintly glimmering stars,
These are two asses that a manger parts."
—ARATUS.

In ancient times Praesepe, or the manger, was regarded in the light somewhat of a weather-guide

Pliny thus refers to it "If Praesepe is not visible in a clear sky, it is a presage of a violent storm"

And Aratus in "Prognostica" wrote —

"A murky manger with both stars
Shining unaltered, is a sign of rain"

According to Macrobius, the name Cancer was selected by the Chaldeans to represent this constellation, because the crab, being an animal that walks backwards or obliquely, well typified the sun's apparent retrograde movement, when it was in this part of the zodiac

"I was born, sir, when the crab was ascending
And my affairs go backward"

—CONGREVE.

According to Greek legend, Cancer represents the gigantic sea-crab that came to the assistance of the water-snake and seized the foot of Hercules as he was fighting with Hydra in the Lernaean marshes. The hero crushed the reptile under his heel and slew it, whereupon Juno, in gratitude for the offered service, importuned Jupiter to place the crab among the constellations.

Another legend relates that Bacchus, while on the way to the temple of Jove, came to a great marsh, over which he was carried by an ass, one of two near by at the time, In return for this gracious service, he transformed both creatures into stars and placed them in the heavens, where they have remained as the "twin asses" to this day

In astrology, Cancer was known as a dark sign and was most unfavourably regarded The Aselli were portents of violent death to such as came under their influence, while Praesepe, or the Beehive, like all clusters, threatened mischief and blindness To the Chaldeans, Cancer, or rather Praesepe, was known as the "Gate of Men," the region of the stars through which, when human beings were born, the souls that were to animate their bodies descended from heaven to earth

The star Acubens, or Alpha Cancri, is a double star of the fourth magnitude, situated in the south-eastern claw, with two very small stars near it Beta, also a fourth magnitude star, is in the south-western claw, midway between Acubens and the bright star Procyon in the Lesser Dog Zeta Cancri is a fine quadruple star near the hind claws of the crab and is one of the most famous of stellar systems Seeliger, of Munich, who has given the system much study, believes that three bright stars in it—of the fifth-and-a-half, sixth, and sixth-and-a-half magnitudes, respectively—revolve round a dark body, apparently the most massive of the four.

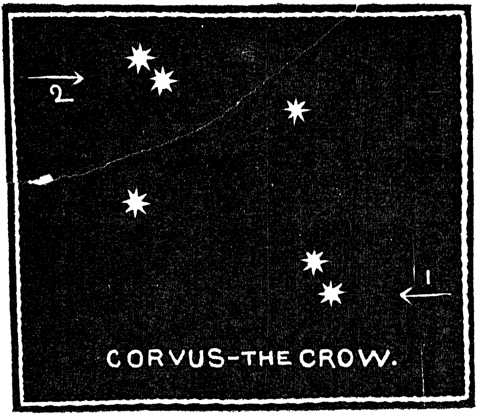
The star Iota is a pretty double, formed by a yellow star of the fourth magnitude and a companion of the sixth magnitude.

APRIL.

CORVUS—THE CROW.

In February I described the large southern constellation Argo, easily indentified by the giant star Canopus Now I want to draw attention again to the southern sky and to describe two much smaller constellations If you look due south about ten o'clock in the evening in mid-April, you will see the well-known constellation, the Southern Cross, due south near the horizon To the left of the Southern Cross and rather higher is the large constellation Centaurus, the Centaur, with two bright stars known as Alpha and Beta Centauri, one of which, *viz*, Alpha Centauri, is the nearest of all the stars Above the Centaur and the Southern Cross stretches part of the long winding constellation Hydra, the Water Snake Just above the portion of Hydra which is due south at this time of the evening, are the two small constellations of which figures are given below. On the left is Corvus, the Crow or Raven, and on the right is Crater, the Cup. Although small and containing no exceptionally bright stars, they are situated in a part of the sky not very rich in stars, and hence are quite easily picked out.

Corvus, the Crow, is figured below.



CORVUS—THE CROW.

This constellation Corvus is one of the ancient forty-eight, and was supposed by some to represent Noah's Raven, his other famous bird being Columba, the Dove, south of Lepus, the Hare, as we saw in February

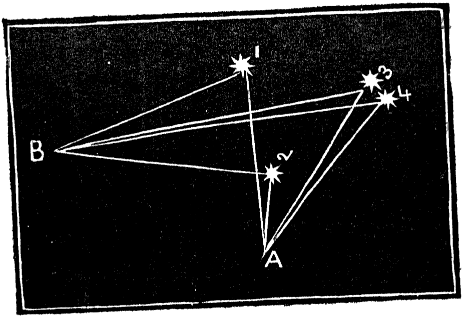
The star marked 1 was formerly the brightest star in this constellation, but it is now only the fourth brightest star in the Crow, so that either it has faded considerably or the other three stars have brightened within historic times—probably No 1 has faded This star marked 1 in the above map is called Al-khiba, which means the tent. This was a name sometimes given by the Arabs to this constellation. It is also called Minkar-al-ghorab, which means the raven's beak, which tells us which part of the constellation was regarded by the ancients as the raven's beak. Looking then at the stars, it is quite easy to imagine them forming a raven standing on the back of Hydra, beak to the right pecking the water-snake's back, very much in the same attitude which one often sees assumed by a crow perched on a buffalo's back in this country.

The star marked *2* is a double star and is called Al-ghorab, which means the raven

In writing these notes, frequent reference has been made to double stars. Double Star Astronomy has a great many enthusiastic followers who spend their time measuring double stars This is done with a telescope, not necessarily a very large one, except in the case of stars which are very close together, a measurement being made of the distance between the two stars, and at the same time the angle which the line joining the stars makes with a fixed direction is determined Now, double stars may be divided into two classes—first, true doubles or binaries as they are called, where we have two stars really close together, each moving round the other as the earth moves round the sun, and secondly, optical doubles as they are called, where one star happens to be nearly exactly behind the other, but a very long way behind, so that, although the stars appear close together, they are in reality very far apart.

By making measurements as described above, we can soon determine whether one star is moving round the other or not, and hence determine to which class the pair belongs. If it is a true double or binary star, then, after a sufficient number of measures have been made, we can determine the period, or time which one star takes to move completely round the other star. This period is usually many years, sometimes many centuries.

The diagram below will make quite clear the difference between true double stars or binaries and optical or false doubles.

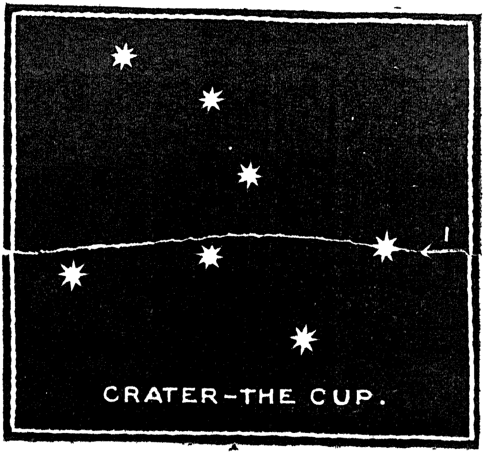


REAL AND FALSE DOUBLE STARS

Seen from the position A, the stars 1 and 2 appear as a close double, although they are really far apart; but seen from the position B, they are seen in their true positions. On the other hand the stars 3 and 4 which are really close together appear as double whether seen from A or B or from any other position.

CRATER—THE CUP.

The constellation Crater, the Cup, which lies just to the west of Corvus, the Crow, is figured below



CRATER—THE CUP.

The star marked 1 in the above map is the brightest star in the constellation, and is called Alkes.

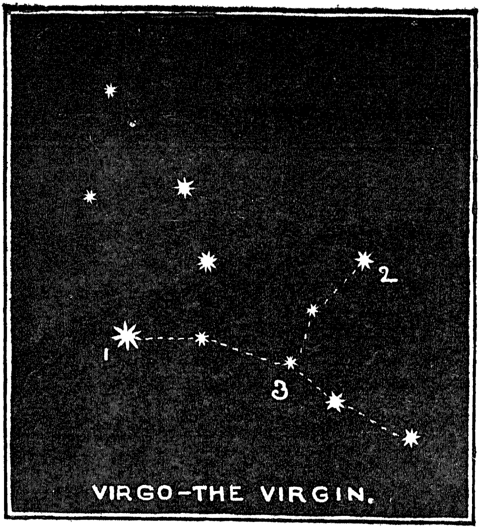
This constellation bears quite a close resemblance to a cup or goblet—a claret cup has been suggested as the nearest approach to it—but it is tilted on one side This, however, was not always so, for this constellation, like Corvus, is one of the ancient forty-eight, and some two thousand years and more ago when these constellations were first formed, the positions of the stars differed a good deal from their present positions, and the cup was then upright when seen due south, so that no apprehension need have been felt then as to the fate of any liquor contained therein We have already remarked on the supposed connection of Corvus and the modern constellation Columba with the patriarch Noah. The constellation Crater has also been associated with Noah, and has been said to be the original goblet out of which Noah first took his wine, now eternally perpetuated amongst the stars of heaven!

Just north of Crater is the large zodiacal constellation Leo, the Lion.

VIRGO—THE VIRGIN.

In the map below, I have figured some of the chief stars of the constellation Virgo, the Virgin, a large constellation which will be found south-east in the early evenings of April. It is easily identified by two features—one the letter Y formed by the principal stars of the constellation, and the other the bright star Spica, marked 1 in the map below.

This is one of the ancient constellations, being the sixth sign of the zodiac, and lies just above the two small constellations Crater and Corvus, just described (the Cup and the Crow), and just east of Leo the Lion.



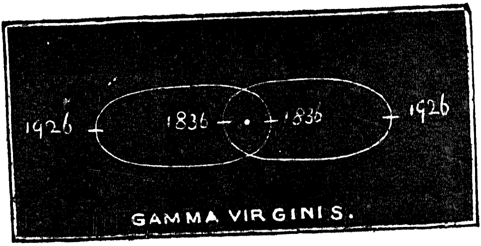
VIRGO—THE VIRGIN

In eastern lands, the Virgin used to be represented as a sun-burnt damsel with an ear of corn in each hand, but the Greeks and Romans depicted her as a winged angel holding wheat ears, signifying the harvest, since the Greek harvest time coincided with the time when the sun approached the bright star Spica. Modern representations of Virgo usually follow those of the Greeks and Romans.

The star marked 2 in the map above is called Vindimiatrix, a Latin name.

The white star Spica, marked 1 in the map, is the most conspicuous object in the constellation, and is the sixteenth brightest star in the sky. It is, like so many other stars in the sky, a double star, but cannot be seen as such with a telescope. It belongs to that class of stars to which I have made frequent reference, known as spectroscopic binaries, the duplicity of which can only be determined with a spectroscope Spica is at a great distance from the earth, and must be an intensely bright star.

The star marked 3 is known as Gamma Virginis, and is a very well known double star. It was first observed as a double star in 1718—the sixth discovery of a double star. These two stars are of equal mass, and each revolves round the common centre of gravity of the pair once in 180 years. The orbits pursued by these two stars are shown below, from which it will be seen that in 1836 they were very close together, and in 1926 they will be as far as possible apart. After 1926, they will begin to close up again, but very slowly, for they will not reach their 1836 position again until the year 2016 A.D.



GAMMA VIRGINIS.

The two stars forming this pair are of equal brightness and equal mass. These two stars, however, vary slightly in brightness Each is normally of about third magnitude, and each in turn decreases about half a magnitude and returns to normal again within a few days

Light takes about forty-two years to travel from this pair of stars to the earth

There are very few double stars which are like this one in being of equal mass and, consequently, travelling in equal orbits Usually one star is much heavier than the other, though it is by no means always true that the heavier is the brighter of the pair

I have called this star Gamma Virginis above, but it really has no name, Gamma being simply the letter of the Greek alphabet which is attached to this star in star maps, and by which it is for convenience known.

THE CONSTELLATIONS IN APRIL.

Instead of describing any more new constellations this month, I shall describe in general terms the positions of the various constellations in the sky which are visible in the early evenings in April

Due north is the Pole Star lying low down near the horizon, with Ursa Minor, the Lesser Bear, stretching horizontally to its right Surrounding Ursa Minor on the right is the sweeping curve of stars forming Draco, the Dragon. High up over Ursa Minor is the great constellation Ursa Major, the Great Bear. All these will be fully described later on. The north-eastern sky is quite bare either of bright stars or important constellations. Turning to the western sky we see a part of the Milky Way stretching across it about midway between the horizon and the zenith. In the lower part of the western sky, two well-known constellations are conspicuous,—Taurus, the Bull, on the right, containing the Pleiades, and the bright red star Aldebaran, while on the left is the great constellation Orion. Well up above Orion is the constellation Gemini, the Twins, with the two bright stars Castor and Pollux —

> "And the starry Gemini hang
> Over Orion's grave low down in the west,"

as the poet Tennyson has so aptly described the situation.

Above Taurus and a little to the right is Auriga, the Charioteer, with the bright star Capella. To the left of Orion is Canis Major, the Greater Dog, with the Dog Star Sirius, the brightest star in the sky. To the left of Gemini in the south-west is Canis Minor with the bright star Procyon, and higher still is Cancer, the Crab.

Turning our backs on the Pole Star and facing south, we see a comparatively uninteresting stretch of sky before us. Low down is Argo, with the second brightest star in the sky, Canopus. Due south and high up is Leo, the Lion, with the bright star Regulus. The only other star with any claim to brightness in the south just now is the star known as Cor Hydrae, the Serpent's Heart, in the long straggling and quite inconspicuous constellation Hydra, which stretches right across the southern sky. A little later in the night, however, the fine constellation Centaurus, the Centaur, and the well-known glory of the southern sky, the Southern Cross, will be visible low down in the south.

Lastly, turning to the eastern sky, we see several interesting constellations. High up are Coma Berenices and Canes Venatici About midway between horizon and zenith, and due east is the giant golden sun Arcturus, marking the constellation Bootes, the Herdsman Away to the right of Bootes is the large zodiacal constellation Virgo, the Virgin, the brightest star of which is known as Spica. Below the northern portion of Bootes is a small semi-circle of stars forming Corona Borealis, the Northern Crown.

Below Virgo we have another sign of the zodiac just rising, *viz.*, Libra, the Scales , and between Libra and Corona Borealis is part of Serpens, the Serpent Below the horizon just about to rise is Ophiuchus, the Serpent Bearer, and lower still is the remaining part of Serpens.

The two most interesting objects visible in the early evenings are the Pleiades and the Praesepe or Beehive Cluster in Cancer. Both these star-clusters are visible to the naked eye, but become considerably enhanced in interest when viewed through a powerful pair of binoculars, while to those who are fortunate enough to be able to view them through a telescope, their beauty is increased an hundredfold. Nor should those who possess telescopes forget that Castor, perhaps the finest double star in the sky, is now well placed for observation.

MAY.

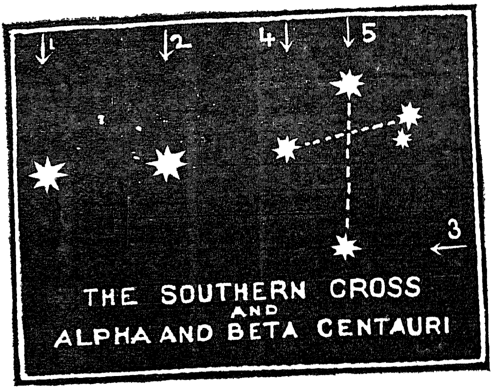
THE SOUTHERN CROSS

I suppose there can scarcely be a reader of this book to whom the Southern Cross is not well known.

The constellation is not visible in England, but we in Southern India are fortunately able to see it from time to time. Further south, in Australia for example, the Southern Cross may be seen high up in the sky, and some Australians seem to regard it as Australian property, and feel quite disappointed that residents in any other country can see it.

In Calcutta, the lowest part of the Southern Cross is just clear of the horizon when on the meridian Here in the south the whole constellation can be quite clearly seen for some time before and after passing the meridian. At this time of year the Cross is well placed for observation just after dinner.

In the figure below, I have shown not only the Cross itself, but also the two bright stars, Alpha and Beta Centauri, easily the two brightest stars near the southern horizon at this time of year



THE SOUTHERN CROSS AND ALPHA AND BETA CENTAURI.

The stars marked 1 and 2 in the map are Alpha and Beta Centauri.

The Southern Cross was first so named by a Spanish explorer, Amerigo Vespucci, who travelled sufficiently far south to observe it early in the sixteenth century. The constellation is also described by Andrea Corsali, who says it is so beautiful that, in his opinion, no other constellation in the sky is worthy to be compared with it.

The Greeks included these stars in the neighbouring constellation Centaurus, the Centaur.

Lovers of Kipling will probably recall to mind his call to southern lands "where the Southern Cross rides high."

The star marked 3, the brightest of the constellation, is the thirteenth brightest star in the sky, and the seventh brightest star south of the equator It is a little more than two and a half times as bright as the Pole Star

This is a triple star, consisting of a close pair with a distant attendant It was one of the earliest discovered double stars, only three being previously known Its compound nature was discovered in 1685 by some Jesuit missionaries sent to Siam by Louis XIV I have often noted in this book how double stars revolve slowly around one another, sometimes completing a revolution in a few years, sometimes requiring centuries In the present instance the period of revolution must be very long Accurate observations of these stars, dating back nearly a century, are not yet sufficient to indicate the exact time of revolution, but it is certainly a period of hundreds, possibly of thousands, of years.

The star marked 4 is at a very great distance from the earth This is also a double star, and observations with the spectroscope have revealed a third component In order of brightness, this star stands twenty-first amongst the host of heaven, while the star marked 5 is so nearly its equal that it stands only two places lower in the list.

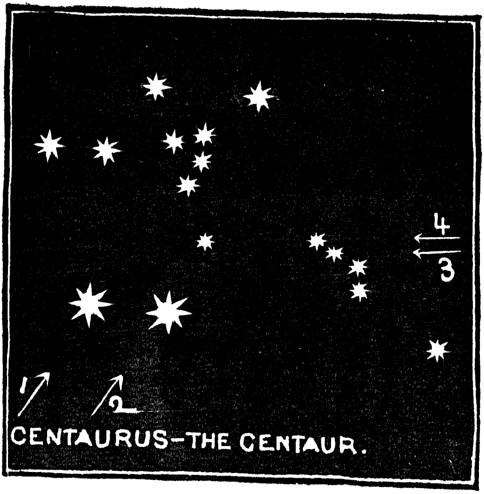
In this constellation is the famous tinted cluster of stars, surrounding a star designated by the Greek letter "kappa."

This cluster may be just made out with the naked eye; with a moderate telescope a few reddish stars will be noted; but with a large telescope and careful study, a number of blue, green, and yellow stars will be noted, so much so that Herschel compared this cluster of stars to a "gorgeous piece of fancy jewellery"

Note—It is the custom of astronomers to designate the bright stars in each constellation by the letters of the Greek alphabet, the brightest star in the constellation receiving the first letter (Alpha), the next brightest star, the second letter (Beta), and so on. This system is independent of the individual names which many of the brighter stars have thus, Alpha Bootis is also called Arcturus, and Alpha Virginis is called Spica, etc The two bright stars, however, which are the leading stars in the constellation Centaurus, the Centaur, have no individual names, and they must, therefore, be referred to by the designations Alpha and Beta Centauri, as above.

CENTAURUS—THE CENTAUR.

If you look due south in the early evening, you will see to the left of the Southern Cross the two very bright stars Alpha and Beta Centauri which are the principal stars of the large southern constellation Centaurus, the Centaur. This constellation, which is figured below, is one of Ptolemy's ancient forty-eight, The stars marked 1 and 2 in the figure are Alpha and Beta Centauri, respectively.



CENTAURUS—THE CENTAUR

No 1 (Alpha Centauri) is one of the most interesting stars in the sky.

To begin with, it is the third brightest star in the sky, being outshone only by Sirius and Canopus But, perhaps of more importance, it is the nearest of all the stars. It was one of the two stars whose distances from the earth were measured first, and it is a very famous double star—the fifth double star to be discovered—though it would doubtless have been observed as a double even earlier had it been visible to European astronomers.

It was first observed as a double star by Richard at Pondicherry in 1689. Recently a third star has been discovered at Johannesburg which also belongs to this system.

The two principal stars of Alpha Centauri circle around one another in a period of eighty-one years, their orbits being very elongated, so that their distance apart varies from about one thousand million miles to about three thousand million miles Each of these two stars is about as heavy as the sun, but they are not quite so bright The two of them together, if placed at the same distance from us as the sun, would only give about one third more light than does the sun.

For a long time, despite all the skill and energies of astronomers, we could not find out for certain the distance of a single star—so far away are they. Some eighty years ago, however, two astronomers attacked the problem simultaneously—one an Englishman, by name Henderson, and a German named Bessel of Konigsberg Bessel succeeded in measuring the distance of a star in the Swan known as 61 Cygni, and Henderson at the Cape of Good Hope succeeded in measuring the distance of Alpha Centauri, which still remains the nearest known star, although the distances of hundreds of other stars have since been accurately measured

Using the same means as so often before of describing a star's distance, we may say that light travelling at the rate of one hundred and eighty-six thousand miles a second, takes only four and one-third years to travel from Alpha Centauri to the earth. Some readers may think that a long time, it is just about the length of time since the present writer left England, so that light which left Alpha Centauri on 1914, February 20, has very nearly reached the earth It should in fact arrive sometime next month* Another way of expressing the distance is to say that travelling by express train at sixty miles an hour, day and night without stopping, it would take fifty million years to travel from the earth to Alpha Centauri.

It takes over a century for the light from Beta Centauri to reach the earth.

The star marked 4 in the map is a double star with a period of a hundred and fifty years.

Near the star 4, at about twice the distance from 4 that 4 is from 3, you will see, if you look carefully on a clear night, a blurred star. You are then looking at a well-known star-cluster known as Omega Centauri (Omega being the last letter of the Greek alphabet of which Alpha and Beta are the first two letters).

Looked at through a large telescope, this is found to be a wonderful cluster of thousands of stars, six thousand four hundred stars have been counted in this cluster and there are many more too faint and too close together to be counted. The great astronomer, Sir John Herschel, described this cluster as a "noble globular cluster, beyond all comparison the richest and largest object of the kind in the heavens."

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* Written in May, 1918.

It is of course not visible from England, so that Europeans dwelling in India should not miss any opportunity which may present itself to them of viewing this magnificent object through a telescope Well over one hundred stars in this cluster have been found to vary in brightness, the periods of variation varying from about six hours up to about sixteen months.

The Centaur of course was an old mythical animal believed in by the Greeks, having the body of a horse and head and shoulders of a man Those who know the story of the Argonauts will remember the Centaur who was tutor to Jason.

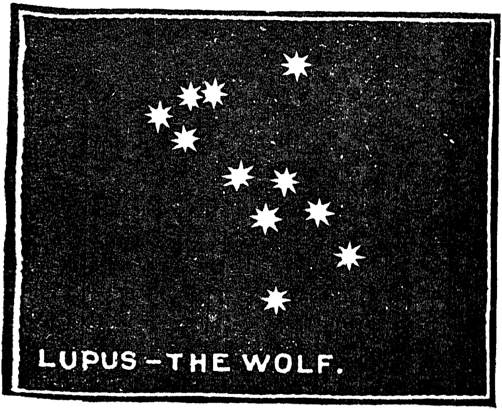
ARA—THE ALTAR, AND LUPUS—THE WOLF.

Near the Centaur is a small constellation known as Ara, the Altar, an unimportant constellation To the left of the Centaur is the constellation Lupus, the Wolf An ancient poet, by name Aratus, who lived about two thousand two hundred years ago, says —

"His right hand he ever seems to stretch
Before the Altar's circle The hand grasps
Another creature, very firmly clutched,
The Wild Beast,—so the men of old it named."

Wild Beast was the ancient name of the Wolf.

Principal stars of Lupus are figured below.

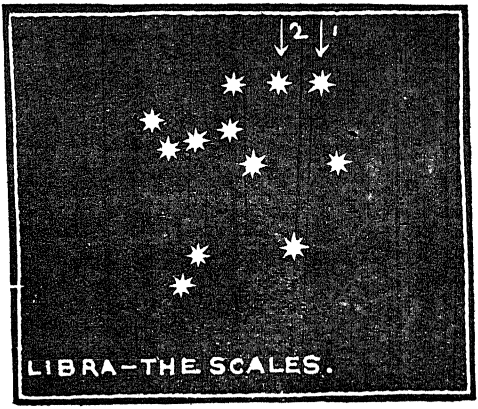


LUPUS—THE WOLF.

constellation occupies the space bounded by Scor- a, and Centaur It contains no very bright star. of the ancient forty-eight, but of course does not the zodiac

LIBRA—THE SCALES.

seventh zodiacal constellation which lies between Scorpio—the Virgin and the Scorpion—is small uninteresting. Nevertheless, as readers may like to be able to identify this constellation, *viz* , Libra the Scales, I give a figure of it below



LIBRA—THE SCALES

None of the stars in Libra are very bright. The constellation lies just outside the Milky Way The star marked 1 in the map is an eclipsing binary It consists of two stars very close together—one is darker than the other, and is circling rapidly round its bright companion once in about every two days Once in each circuit it passes in front of the brighter star and partially eclipses it, so that for some hours in every two days the star appears less bright than usual. The star marked 2 is a green star.

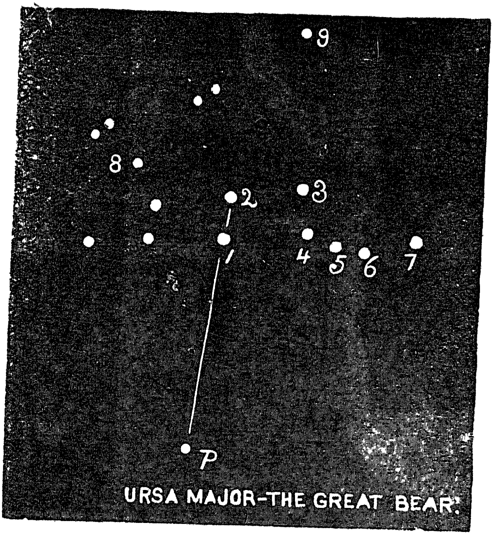
There is a story that originally there were only eleven signs of the zodiac and that the stars which now form Libra formerly formed the claws of the Scorpion, Libra being a later addition to the zodiac. This story comes down to us from a Roman writer, by name Servius, and we may say in its favour that the word "zodiac" means a circle of animals, and all the other eleven signs are animals, so it seems strange that a pair of scales should have got in amongst them. On the other hand, many modern writers affirm that there is ample evidence to the effect that Libra was included in the ancient Chaldean and Egyptian zodiacs

Libra is considered (so says one astronomer) as testifying the equality of the days and nights in the autumn (when the sun is in Libra) as well as the uniform temperature of the air at that season

JUNE.

URSA MAJOR—THE GREAT BEAR, AND THE POLE STAR.

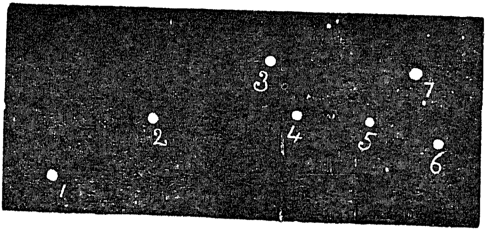
If any night after dinner at this time of year you will stand facing due north, you will see well up in the sky and a little to your left a fine group of seven bright stars These seven stars are part of the constellation of the Great Bear, and alone they form the constellation of the Plough, or as it is termed in America the Dipper The relative positions of the stars are shown in the accompanying illustration The stars are usually designated by Greek letters, but since Greek letters may not be familiar to some readers they are replaced in the illustration by the numbers 1 to 7.



THE GREAT BEAR AND THE POLE STAR.

The remaining stars shown, with the exception of P, complete the constellation of the Great Bear You will notice that a line drawn through 1 and 2 almost exactly passes through the bright star P Once you have located the Plough you have only to follow with your eye the line through 2 and 1 downwards to find this star in the sky This is the Pole Star, and it is important to know this star for two reasons Firstly, whenever you look towards this star you are looking north, and this star therefore acts like a compass; in the second place the altitude of this star above the horizon reckoned in degrees will give you your latitude. At the equator this star would be just on the horizon, at the north pole it would be immediately overhead, and at intermediate latitudes it would be at corresponding altitudes. in the southern hemisphere it is always invisible.

To return to the Plough, a few facts about these stars may be of interest They are all very much larger and brighter than the sun Close to the star 6 is another fainter star, and all these eight stars are in swift motion; not only are they in swift motion through space, but six of them, nos. 2, 3, 4, 5, 6, and the small one just mentioned form one party; they travel at the same rate and in the same direction, and this in spite of the fact that they are in reality millions of miles apart from one another! The other two stars 1 and 7, are both in motion, but at different rates and in different directions. Hence these stars will not always keep the same positions with respect to one another, for example, 100,000 years hence they will appear as shown below —



THE PLOUGH 100,000 YEARS HENCE

It will be seen that 2, 3, 4, 5 and 6 are much the same as in the first figure, but 1 and 7 occupy quite different positions.

The stars marked 1 and 2 are often termed the Pointers, because they point to the Pole Star, as shown in the figure. No 1 is called Dubhe from the Arabic Dubb, meaning a bear No. 2 is called Merak from the Arabic Merak-al-dubb-al-akbar, the loins of the great bear No 1 is a red star, but its colour varies slightly, being at times more yellow than red. The star marked 3 is called Pheeda. No 4 is named Megrez from Megrez-al-dubb-al-akbar, meaning the root of the great bear's tail No. 5 is called Alioth. No. 6 is called Mizar. No 7 is called Alkaid or Benetnasch, from the Arabic Al-kayid-al-benat al-nash, meaning the governor of the mourners.

No. 6 is a very interesting star. Anyone with clear sight who looks at it on a fine night will see close by another small star called Alcor. This pair was well known to the Arabians, who considered the ability to see the two stars Mizar and Alcor separately a good test of eyesight. But

Mizar itself consists of two bright stars close to one another, this fact having been first discovered by Riccioli at Bologna in 1650, the first recorded discovery of a telescopic double star Even in a small telescope the pair of bright stars can be seen, while the companion star Alcor shines not far away. Besides Alcor and the companion just noted, another star is associated with Mizar, revolving round it once in twenty days. This star is so close that even the most powerful telescope cannot separate it, but its presence is detected by means of the spectroscope, so that Mizar belongs to the class of stars known as spectroscopic binaries Alcor has probably considerably increased in brightness within historic times, for it was unknown to the Greeks, and as stated above was considered a good test of eyesight by the Arabs, whereas anyone with ordinarily good eyesight can now see it.

The reason why the Great Bear has such a long tail is given in an old book on astronomy written in 1590 as follows (I retain the old English spelling) in dialogue form —

SCHOLAR —" I marvell why (seeing she hath the forme of a beare) her tail should be so long "

MASTER —" Imagine that Jupiter, fearing to come too nigh unto her teeth, layde holde on her tayle, and thereby drewe her up into heaven, so that shee of herself being very weightie, and the distance from the earth to the heavens very great, there was great likelihood that her taile must stretch. Other reason know I none "

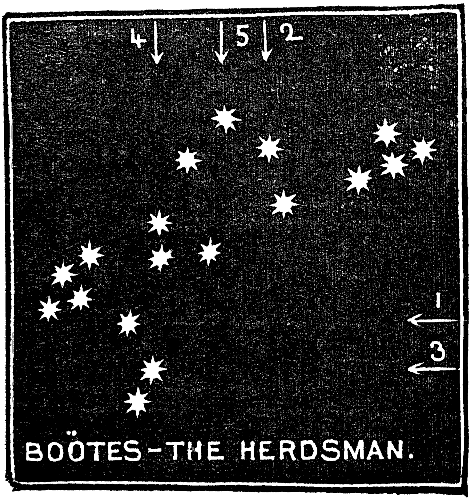
The tail is of course formed by the stars marked 5, 6 and 7 in the map above

The star marked 8 is a comparatively near star. Light takes just about one-third of a century to travel from this star to the earth The star is moving through space with a speed of over forty miles a second. Another very faint star close by is moving at the same rate

No 9 is a star of considerable interest It was discovered to be a double star by Herschel in 1780, and in 1828 an astronomer calculated the motion of the two stars on the assumption that the one star revolved around the other, just as the earth revolves around the sun. He found that the actual motion of the stars agreed with his calculations. We now know that there are many pairs of stars thus revolving under the influence of gravitation, but this was the first star whose motion was actually predicted by calculation. The period taken by one star of this pair to revolve around its companion is sixty years A third star also belongs to this system Both the stars of this pair must be very bright, since they are at a great distance from the earth. Both the size and luminosity of their surface must be considerable. The orbit of these stars is not circular like our own orbit, but very elongated, more like the orbit of a comet. It really comes between the two, less circular than the earth's orbit, less elongated than that of a comet

BOOTES—THE HERDSMAN.

High overhead in the evening at this time of year you will see a very bright star of a golden yellow colour. This is the star Arcturus, the principal star of the constellation Boötes—the Herdsman. It is No. 1 in the map of Boötes given below, which shows the constellation as it appears a little later in the evening, when it has passed the zenith and may be seen well up in the western sky



BOOTES THE HERDSMAN.

Arcturus is at a considerable distance from the earth, light occupying about a century and a quarter in journeying from Arcturus to the earth. Were it no farther off than our own sun it would appear about one thousand times as bright. It is travelling very fast through space, at the rate of about two hundred and fifty miles a second! It is the sixth brightest star in the sky.

The amount of heat which reaches the earth from Arcturus has been measured by a very delicate instrument which could measure a change of temperature of one ten-millionth part of a degree, and it was found that 150,000 times as much heat is received from the moon as is received from Arcturus, though were Arcturus no farther off than our own sun, everything on the earth would be burnt to a cinder by the terrific heat

The amount of heat which the earth receives from Arcturus is the same as the amount of heat which would reach us from a candle placed at a distance of five miles!

Arcturus is mentioned in the book of Job, but this is a mistranslation, Ursa Major—the Great Bear—being the correct version

Bootes is one of the ancient forty-eight constellations, and by the ancients was sometimes called Arctophylax—the Bear-keeper

The ancient poet Aratus, who lived about 300 B. C., and whom I have often quoted before writes —

> "Behind and seeming to urge on the Bear
> Arctophylax, on earth Bootes named
> Sheds o'er the Arctic car his silver light."

Bootes has also been termed Atlas The Herdsman is usually represented as a robust man with the left hand raised and the right hand holding a club The upraised hand holds the leash of the hunting dogs represented by the neighbouring constellation Canes Venatici

On the 5th October, 1858, a large comet, known as Donati's comet,passed right in front of Arcturus, which shone through the head of the comet with undimmed splendour

The Chinese called Arcturus " the palace of the emperors "

Several other stars in this constellation have names That marked 2 is called Nekkar, No 3 Muphrid, and No 4 Izar from the Arabic word meaning a zone or girdle This star is a fine double, the two components which are fairly close together being pale orange and seagreen in colour, the former being some thirty or forty times brighter than its companion Struve, one of the greatest observers of double stars who ever lived, described it as "pulcherrima," which is Latin for "very beautiful." Finally the star marked 5 in the above map bears the name Alkalurops, from Al-kalurops which means a shepherd's crook or herdsman's staff

In the map above the star marked 2 marks the herdsman's head, the group of stars on the extreme right of the map marks the uplifted left-hand holding the hunting dogs' leash, and No. 3 marks the left leg, No 4 the girdle, No 5 the upper end of the club held in the herdsman's right hand It will be seen that at present the herdsman is not quite upright in the sky To the west of Bootes is the large zodiacal constellation Virgo, with the bright star Spica described in April. To the west and slightly to the north of Arcturus is Coma Berenices the Hair of Berenice—which has also been described recently. Canes Venatici—the Hunting Dogs—a small modern constellation, lies just north of Coma Berenices and north-west of Boötes.

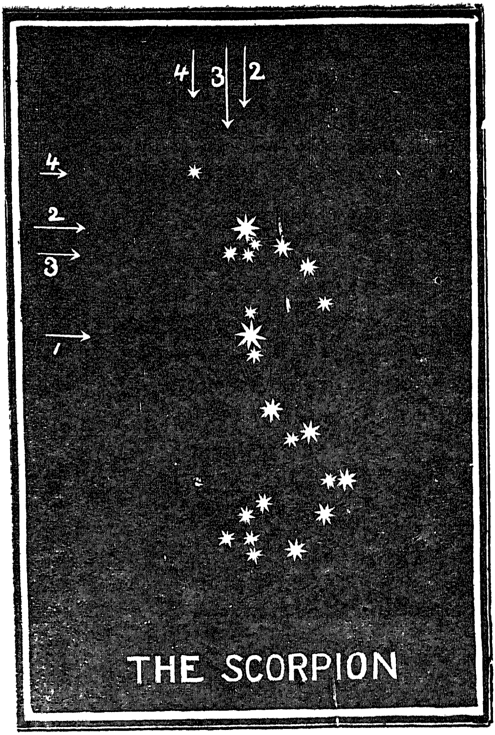
The only other constellation of which much can be seen in the western sky at this time of year is Leo—the Lion—whose brightest star Regulus is almost exactly due west and rather low down Leo lies to the west of Coma Berenices, with the small constellation Leo Minor just above its northern portion The greater part of the north-western sky is now occupied by Ursa Major—the Great Bear.

It is highly probable that the ancients who first formed the constellations imagined Bootes as chasing or driving Ursa Major, and hence their name for this constellation of Arctophylax or Bear-keeper, and it was probably the idea of Bootes as a hunter that led Hevelius to supply him with a pair of hunting dogs when he inserted the constellation Canes Venatici in the sky

SCORPIO—THE SCORPION.

The constellation Scorpio (the Scorpion) is just now finely placed for observation in the evening It will be found about 8 p m , high up in the sky to the south-east Any one who looks in this direction cannot fail to have their attention arrested by a very bright star, with a curving line of three other fairly bright stars a little way above it

It should be easy to identify the whole constellation from the illustration,



SCORPIO—THE SCORPION.

The star marked 1 is the bright star referred to above. A casual glance is sufficient to note that the star is of a fiery red colour. It is called Antares, which means rivalling Mars, because it is the only star which is bright enough and red enough to be comparable with Mars. It is a double star, but it requires a telescope, though not a very large one, to see it as such. The second star is of a bright green colour.

The star numbered 2 is named Acrab This is really a triple star, but can only be seen as such with large telescopes. There are several other multiple stars in this constellation That marked 3 consists of four stars, two bright ones very close together and two a little less bright and a little farther apart, and the star at the top of the illustration marked 4 is a triple system The two principal stars circulate round one another once in 104 years, and there is a third slightly fainter star at some distance away We have mentioned above that the bright star numbered 2 is a triple system, but it is really a quadruple, for there is a fourth star which is too close to be seen even with the largest telescopes, but which is revealed by the spectroscope—an instrument which often reveals double stars otherwise beyond our ken. The fourth star is so close to 2 that it revolves round it in less than seven days, about six days and 21 hours.

Antares is just a little brighter than the star in the Lion referred to in March, and the two stars are at almost exactly the same distance from the earth

An idea of their distance may be gained from the following —

Light travels at the enormous rate of 186,000 miles per second Travelling at this enormous rate it takes about 8 minutes to reach the earth from the sun, a distance of 93,000,000 miles, but this is nothing to the time light takes in its journey from Antares or Regulus This jo occupies 150 years! Supposing, for example, that A were suddenly to stop shining to-morrow we should not it till about 2066 A D !

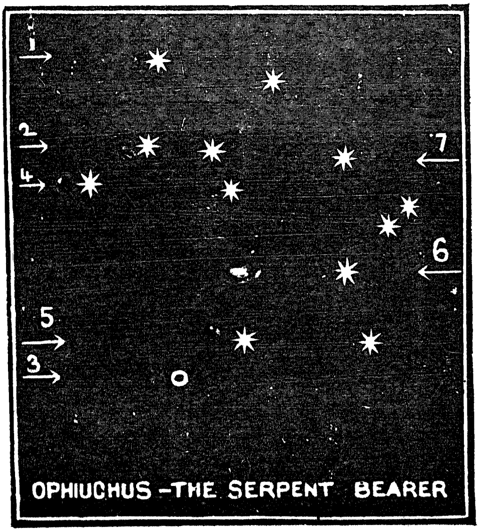
The Scorpion is one of the old Zodical signs T Hindu name was adopted from the Greek, *viz*, Ka from the Greek Skorpios

It is a curious fact that new stars always appear very near to the Milky Way Now the greater part of Sc and part of its neighbouring constellation Ophiuchus Serpent-bearer—lie in the Milky Way, and in the region sky occupied by these two constellations more new stars been seen than in any other similar area of the sky. new stars have appeared in Ophiuchus and six in Sc the dates of the apparitions in Scorpio being 134 B.C first authentic record of such an apparition, a new star was observed by the famous astronomer Hipparchus A D, a new star in the Tail of the Scorpion, a new observed for four months at Babylon about 827 A D, an in the year 1006 A D described by Epidamnus, the mo St. Gall, as "oculos verberans," In July, 1203, anoth the Tail of the Scorpion, said to have resembled Saturn, then after a lapse of six and a half centuries another in Sc in 1860 This remarkable grouping of these objects in part of the sky can scarcely be accidental, though the sig cance of it is not yet comprehended by astronomers.

JULY.

OPHIUCHUS—THE SERPENT BEARER.

If you look due south in the early evening you will see the large constellation Scorpio—the Scorpion—with the bright red star Antares, which was described last month Above Scorpio is the long constellation Serpens—the Serpent—cut in half just above Scorpio by the constellation Ophiuchus—the Serpent Bearer—which is figured below —



OPHIUCHUS—THE SERPENT BEARER.

Ophiuchus is supposed to represent a giant treading on the Scorpion and crushing the Serpent in his hands.

The star marked 1 marks the giant's head, his legs are set wide apart, the right in the Milky Way with heel on the Scorpion's tail, the left planted on the Scorpion's body. The star marked 4 above marks the right shoulder, while 5 and 6 mark the giant's knees The two stars to the right of 6 in the above map mark the left hand which holds the Serpent by the neck, while the right hand holds the Serpent's tail.

The ancient astronomer Aratus refers thus to Ophiuchus —

His feet stamp Scorpio down, enormous beast,
Crushing the monster's eye and platted breast,
With outstretched arms he holds the Serpent's coils,
His limbs it folds within its scaly toils,
With his right hand its writhing tail he grasps,
Its swelling neck his left securely clasps,
The reptile rears its crested head on high,
Reaching the seven-starred Crown in northern sky."

According to Greek mythology Ophiuchus represents the famous physician Aesculapius, who became so skilled in medicine, that not only could he cure men of their ills, but even brought them back to life when they were dead, so much so that Pluto, the god of the underworld, complained to Zeus that his kingdom was becoming depopulated.

Thereupon Zeus slew Aesculapius with a thunderbolt, but subsequently, at Apollo's request, placed him among the constellations!

Another tradition identifies Ophiuchus with Laocoon, who with his two sons was killed by two sea serpents during the siege of Troy, a story which has inspired one of the finest groups of sculpture extant

The brightest star in the constellation is that marked 1 in the map, and is named Ras Alhague, which means the "head of the serpent charmer" This is a blue star with a faint companion , it is moving through space at the rate of about sixteen miles a second, and is at such a distance that its light takes forty four years to reach the earth.

The star on the extreme right of the above map is called Yed , it is yellowish in colour, and has a faint companion of a pale lilac colour.

The star marked 5 is called Sabik.

The star marked 7 is called Marfik, and has a close but fairly bright bluish companion.

The star marked 4 is a well-known double. The distance between the two stars is twenty eight times the distance separating the earth from the sun. One of the two weighs twice as much as the sun, and the other is about half as heavy as the sun They revolve around one another in a period of eighty-eight years, and are comparatively near to us.

Several new stars have appeared at different times in Ophiuchus In the year 123 A D and 1230 A.D. new stars were observed in this constellation, while in 1604 Maestlin discovered a bright star on Oct 9 in the position marked 3 in the map The following night it was seen by Galileo at Padua, and it soon outshone Jupiter, Kepler described it as " sparkling like a diamond with prismatic tints " By March 1605 it had sunk to the third magnitude and a year later had vanished There is now no star to be found in this place

On April 28, 1848, a new star was discovered in Ophiuchus by Hind, of the sixth magnitude and intensely reddish yellow colour Four days after discovery it was brighter than the fifth magnitude, and then it faded slowly, and in 1875 was of the thirteenth magnitude

Both Ophiuchus and Serpens belong to the ancient forty-eight constellations The former is a Greek name, the latter a Latin one The Greek name for Serpens was Ophis and the Latin name for Ophiuchus, Serpentarius.

This constellation contains—besides the double stars mentioned above—several clusters and eclipsing variables. The star marked 2 in the map is called Cebalrai.

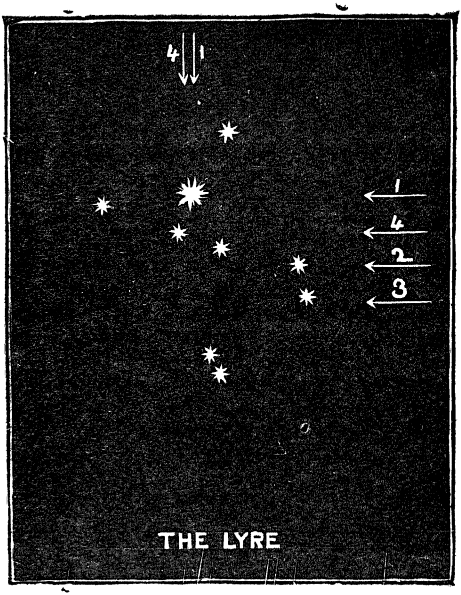
Although Ophiuchus is not one of the signs of the zodiac, it crosses the Ecliptic (or sun's path), and the sun occupies about sixteen days in passing through this constellation about the beginning of December,

LYRA—THE LYRE.

In the north east sky early in the evenings of July there is one conspicuous star which completely outshines all others in this region of the sky This is the bright star Vega, the brightest of all the stars in the northern half of the sky. The star is double, but the second star is only visible with a large telescope Vega is of a bluish white colour, a great contrast to Antares, described in June.

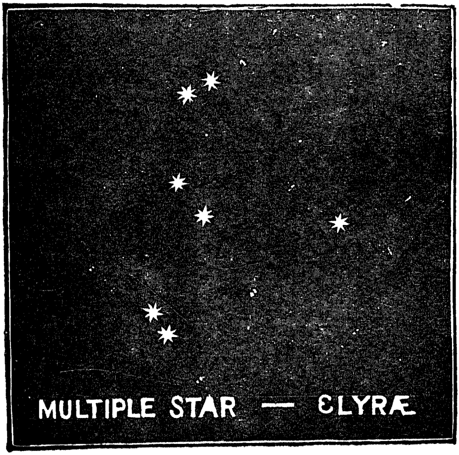
A few pages back we described how to find the Pole Star, and the description will hold good for some generations to come, but the time will come when the present Pole Star will cease to denote the pole of the sky, *i e.*, the point about which all the stars revolve This is due to what is technically termed the Precession of the Equinoxes, which has the effect of slowly altering the point about which the stars revolve. Such is this movement of the Pole that about 12, 000 years hence Vega will be Pole Star, and instead of being seen in the north east in the summer evenings will be always due north throughout the year

Vega, in spite of its brilliance, is at a considerable distance from the earth—though it ranks as comparatively near in comparison with most of the stars Light travelling at the rate of 186, 000 miles a second, would take 40 years to travel the distance that separates us from this star. Vega is the brightest star of the constellation Lyra (the Lyre) which is figured below,



LYRA—THE LYRE

In the above figure Vega is marked 1 The star marked 2 is named Sheliak This is a variable star, the brightness varying in a period of about 13 days When it is brightest it gives about two and a half time as much light as it does when it is least bright No 3 is called Sulaphat No 4 is an interesting star It is a double star Anyone with good sight can see that it is double, but each of the stars which can thus be seen is also found to be double when viewed with a telescope Each star of each pair is revolving slowly round its companion, and each pair is revolving round a point between the two pairs Between the pairs are three smaller stars, so that the whole form a system as shown in the illustration below—quite a family group !



MULTIPLE STAR—ε LYRE

Anyone possessing a small telescope will find this an object well worth looking at Between the stars marked 2 and 3 is another object which can be seen with a small telescope. This is the annular nebula in Lyra, which shows as a bright oval ring.

Above Lyra is a large constellation—Hercules—but it contains no star of out-standing brilliancy, though it contains many interesting objects and will be described in due course.

Due east and quite low down about 8 p.m you will find another bright star This is Altair, the brightest star in the Eagle, but it will be better to wait until this constellation is a little higher in the sky before giving a detailed description of it.

If you look overhead about 8 p m. you will see the very conspicuous bright star, Arcturus, and a little way to the south of it another bright star, Spica These belong to the constellations Bootes (the Bear Keeper) and Virgo (the Virgin) respectively You should now be able to identify the brightest stars visible at this time of the year, *viz.*, Regulus, Antares, Vega, Altair, Arcturus, and Spica, and the bright stars of the Centaur and the Southern Cross which may be seen well to the south.

The following lines descriptive of Vega, were written by an American astronomer poet a few years ago ·—

VEGA.

Like a starry diamond sparkling bright and high,
  The Harp's great beacon blazes mid the night,
An azure gem against an ebon sky
  Where eastwardly the Swan-Cross twinkles white !
When Leo reigns and harvest time draws nigh,
  And Sol forsakes his kingdom's northern height,
When sultry dog-days pass so slowly by,
  Then queenly Vega glitters on our sight.

Harp in line 2 is of course an alternative to Lyre, the reference to the Swan-Cross is to the constellation Cygnus (the Swan) to the east of Lyra, *i e*, low down early in the evening, the principal stars of which form a cross Line 6 refers to the passing of the Sun from the most northern point of his path at the end of June.

According to a legend current in China and Japan, the bright star Altair is a shepherd boy who fell in love with Vega, a spinning damsel ; but the girl's father objected to the match, and so he banished them both to the sky where they are placed one on each side of the Milky Way which is supposed to represent a river They are allowed to meet once a year on July 7 if they can manage to cross this river Consequently on this night their friends the magpies form a bridge across the river, over which the lovers pass, and spend 24 hours in company But if it rains on this night the river becomes too swollen and the meeting cannot take place that year This is the origin of a Japanese festival called Tanabata It is said that if Korean children find a magpie on July 7 they stone it as a punishment for not having taken its share in forming the bridge across the Milky Way.

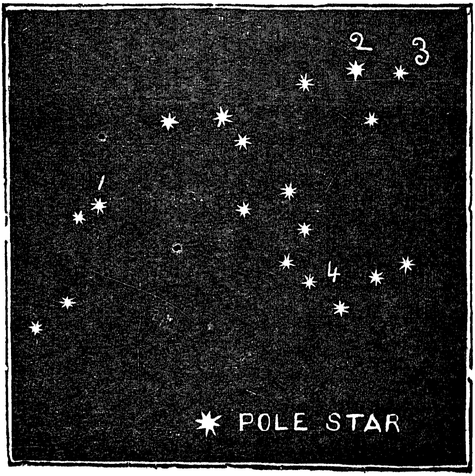
Longfellow refers to Lyra thus —

" I saw with its celestial keys,
Its chords of air, its frets of fire,
The Samian's great Æolian lyre,
Rising through all the sevenfold bars,
From earth unto the fixed stars."

The third line refers to the fact that Lyra is supposed to represent the harp which Apollo presented to Orpheus.

DRACO—THE DRAGON

In June we described how to find the Pole Star, which is always due north If you will look due north about 9 p.m. on a clear night there should be no difficulty in picking out this star. Away to the left at this time of year will be seen the Great Bear, and straight over the Pole Star is the large constellation Draco (the Dragon) The principal stars are figured below, the Pole Star also being shown



THE DRAGON AND THE POLE STAR.

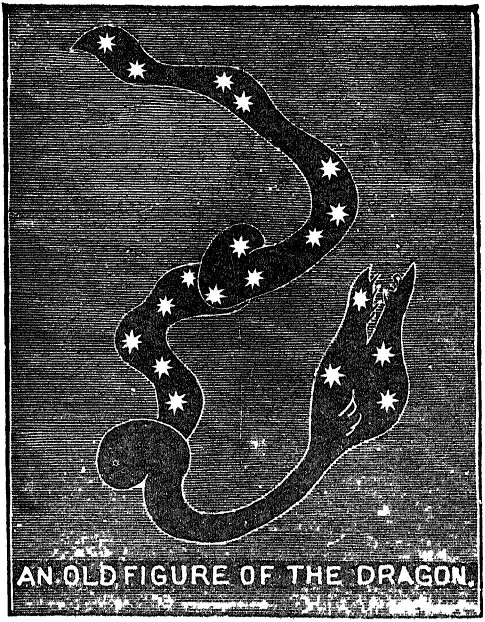
When writing of the Lyre, I mentioned that in a few thousand years Vega would be the Pole Star . a few thousand years ago, the star marked 1 in the above figure was the Pole Star, in the days of the Chaldeans. It is called Thuban from the Arabic for Dragon.

The brightest star in the constellation is that marked 2 and is called Alwaid.

No 3 is called Etamin from the Arabic Ras-el-tennin the dragon's head

No 4 is moving away from the earth with a velocity of 20 miles per second

I give below an old picture of the Dragon, which however makes it out more of a snake than the conventional dragon ,—


AN OLD FIGURE OF THE DRAGON.

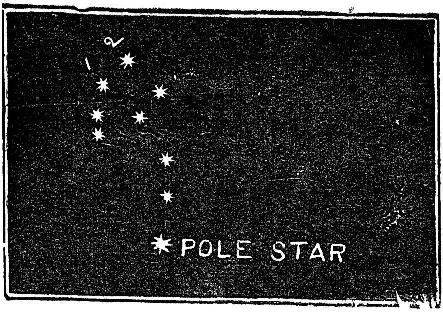
AN OLD FIGURE OF THE DRAGON

Most writers agree that the stars marked 2 and 3 in the map I have given of the Dragon mark the monster's head, but there are many different ways of figuring the animal One well-known writer, evidently bent on producing something like the common idea of a dragon, borrows a star from the neighbouring constellation Hercules to complete the head, and also borrows about half of Ursa minor in order to enable him to provide the Dragon with a pair of wings Even then the final result hardly comes up to my idea of a legendary dragon.

This constellation Draco is one of the ancient forty-eight In more northern latitudes it never sets, and is visible throughout the night all the year round. Here in Southern India, however, it is only during the summer months that the constellation is visible all night The Great Bear also disappears below the horizon, and is absent from our night skies for some months of the year.

URSA MINOR—THE LESSER BEAR

The space between the Pole Star and the Dragon is occupied by Ursa Minor, the Lesser Bear, of which the Pole Star itself is the most important star The Pole Star has in fact been described as the "most practically useful star in the sky" I described how the star always designates the north, and also determines the latitude I also described how it may readily be found by means of two bright stars in the Great Bear which are usually termed the "Pointers," because whatever their position in the sky they always point to the Pole Star. The stars of this constellation are omitted from the figure of the Dragon, to save confusion, and are shown separately below.—



URSA MINOR—THE LESSER BEAR

Early in the evening at this time of year the constellation is seen running in a vertical line from the Pole with the Dragon enclosing it in a great curve as shown above in the first figure. The shape of the constellation is much like that of the principal stars forming the Great Bear, but it is much smaller and the stars composing it are not nearly so bright The stars marked 1 and 2, which are the two brightest next to the Pole Star, are called the Guardians of the Pole—because they circle round the Pole Star at a short distance from it No 1 is called Kocab from the Arabic Kaukab-al-shemali, the north star, because about 2, 000 years ago this star was the Pole Star

To these two stars, which were used by old-time mariners as a clock, since they could tell the time by the position occupied by these stars, many references may be found in literature. (See for example Othello, Act II. Scene 1).

This constellation was at one time called Cynosura, which means Dog's Tail, and since the sailors were constantly gazing at it, in order that they might steer their ships correctly—before the invention of the mariner's compass, the word "cynosure" came to have its modern meaning.

The constellation is a very ancient one. It is included in Ptolemy's forty-eight, and is referred to by Aratus, but it is said to have been first formed by Thales, who lived some 2,500 years ago, and was the first astronomer so far as we know to predict an eclipse of the sun. The story of this eclipse is sufficiently interesting to permit a digression to tell it. For five years the Medes and Lydians had been at war. On the very day that Thales had predicted the eclipse a battle was in progress, when as sunset drew near the eclipse of the sun actually took place, and so impressed were the Medes and Lydians that they stopped fighting and made peace on the spot! Of the Pole Star also many quotations from literature might be made I content myself with quoting a few lines from Bryant's "Hymn to the North Star":—

"On thy unaltering blaze
The half-wrecked mariner, his compass lost,
Fixes his steady gaze,
And steers undoubting to the friendly coast;
And they who stray in perilous wastes by night
Are glad when thou dost shine to guide their footsteps right."

The Pole Star itself is a double star, which in higher latitudes can be seen with quite a small telescope, but in these low latitudes it would probably only be so visible on an exceptionally clear night.

The distance of the Pole Star from the earth is about three million times the distance between the earth and the sun.

The Milky Way or Galaxy (which is the same thing in Greek), as it is called by astronomers, is now well seen on a clear night, stretching in a broad white band across the sky. Some of the most brilliant parts are to be seen fairly high up to the south, these regions are worth examining with a good pair of field glasses, when they will be seen to be simply ablaze with stars, good photographs of these regions show millions of stars so close together that it is impossible to separate one from the other

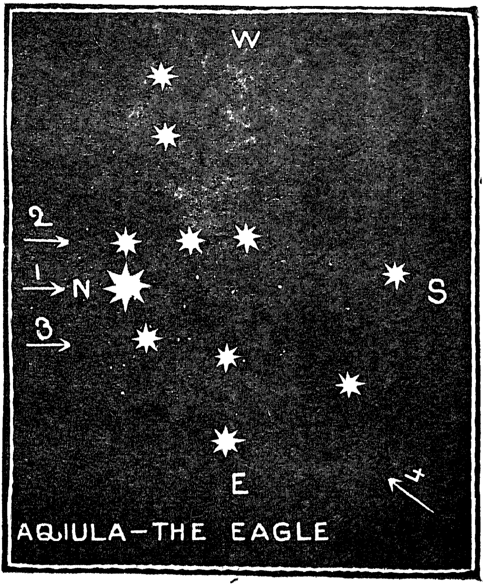
The following lines are descriptive of the Milky Way.—

> A broad and ample road, whose dust is gold
> And pavement stars, as stars to thee appear,
> Seen in the galaxy, that Milky Way
> Which nightly as a circling zone thou seest,
> Powdered with stars.

AUGUST.

AQUILA—THE EAGLE

In the early part of the evening at this time of year the Milky Way may be seen stretching across the eastern sky, high up towards the zenith Due east and involved in the lower part of the Milky Way may be seen the constellation Aquila, the Eagle This constellation was at one time divided into two, Aquila and Antinous, but both are now regarded as one constellation under the name Aquila

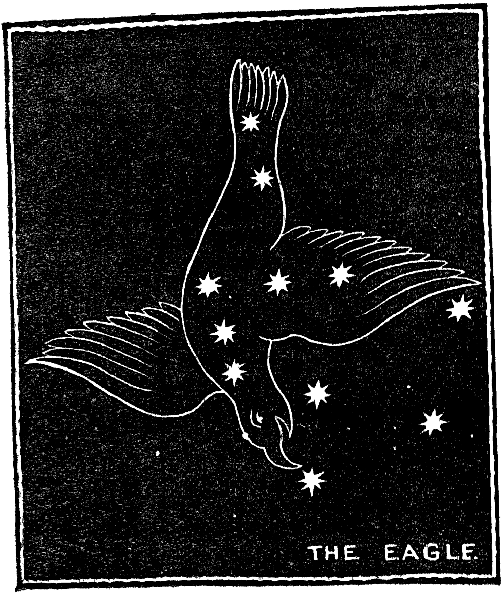


AQUILA—THE EAGLE.

The stars numbered 1, 2 and 3 above are called respectively Altair, Tarazed and Alshain These three stars point to the bright star Vega in the Lyre, in a northerly direction

Altair is the brightest star in the constellation, and is so called from the Arabic El-nesr-el-tair, the Eagle flying, which was the Arabic name of the constellation, the Lyre being termed El-nesr-el-waki, the Eagle falling, hence the name Wega or Vega for the principal star of this latter constellation.

The illustration below shows the manner in which the Eagle is usually represented in modern maps, though it will be seen that it fails to include all the stars When the



THE EAGLE.

constellation is high overhead the Eagle is seen in a better attitude, flying as the Arabs imagined it to be

Altair is a comparatively near star, light takes only 14 years to reach the earth from this star It is just about three times as far away as the nearest star, the bright star Alpha in the southern constellation of the Centaur

The part of the Milky Way around Aquila is well worth studying with a small telescope, and will be found to be rich in pairs and groups of stars

My readers may remember seeing telegrams in the newspapers in June 1918 announcing the apparition of a new star in Aquila The new star appears to have been first seen in England on June 8th, and was first discovered in India on the 8th or 9th by Mr C L Dundas I C S of Jhelum Spectroscopic as well as visual observations of the star were obtained at Kodaikanal on June 11 and succeeding nights, and the region was photographed on the 12th, so that no time was lost in observing the star in India *

From time to time a "new star" suddenly blazes up in the course of a few hours in a place where no star has been previously seen It then slowly, and at times spasmodically,

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* Mr Dundas was the first to send observations of the new star to Kodaikanal Observatory, but it appeared afterwards that Mr G N Bower of Madras had been the first discoverer He observed it and recorded its magnitude in his notes, between 9 and 10 p m on June 8, which was about five hours earlier than it could be seen in England, the corresponding time there being 3-30 to 4-30 p m

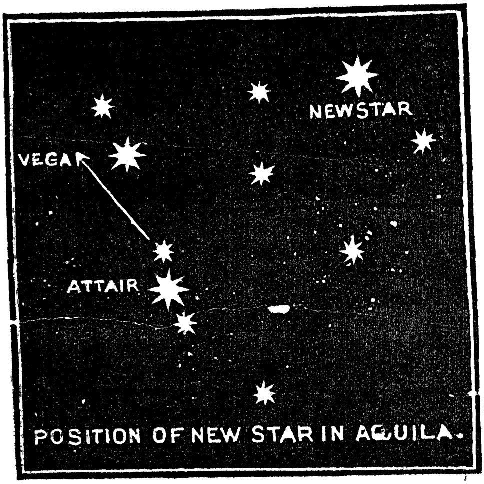
Mr Pocock was visiting Kodaikanal when Nova Aquilae appeared, and it was largely due to his very efficient help that early and excellent photographs were obtained of the spectrum

M A E

fades away, its spectrum undergoing a regular series of changes as the star fades.

The star of 1918 must have blazed up in the course of a few hours from invisibility to the first magnitude On June 8th it was of magnitude 0 9, two days later it was fully half a magnitude brighter, it then began to fade. At its brightest it nearly equalled Vega, but two days later was about equal to Altair

The star was very conveniently situated for observation, rising soon after sunset almost due east, and being visible all night Like all new stars it lay in the Milky Way, but just at the point where the star was there is a great dark rift separating the Milky Way into two branches, and the new star lay right in the centre of this dark rift It is not now visible to the naked eye, but the map below shows its position



POSITION OF NEW STAR IN AQUILA, JUNE 1918

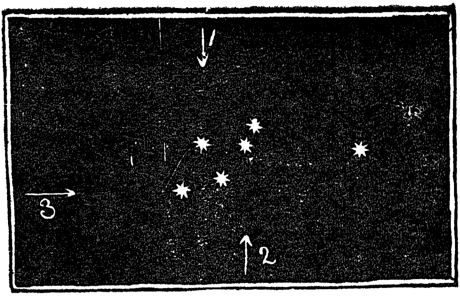
The star just to the left of the new star in the above map belongs to the constellation Serpens—the Serpent All the rest belong to Aquila—the Eagle

This is the fourth new star discovered in the constellation Aquila, the last three having been discovered in the last twenty years The first new star in Aquila of which we have any record was seen in the year 889 A D close to Altair, and is said by Cuspinianus to have equalled Venus in brightness It vanished after three weeks In 1899 a new star was discovered in Aquila on photographic plates taken at the Harvard College Observatory In 1905 another similar discovery was made at Harvard, and the discovery of 1918 completes the list of new stars discovered in Aquila.

The star followed very much the course of other new stars, fading fairly rapidly with one or two slight fluctuations in brightness, and with the usual corresponding changes in colour and spectrum The most interesting point about it is perhaps that it appears to be identical with a star already known of about the ninth or tenth magnitude, whereas usually no star is known to exist in the position where a Nova has appeared In the present case there are numerous photographs extending back more than twenty years showing this faint star, exactly in the position of the Nova There is some slight evidence also that this faint star was previously slightly variable in brightness

DELPHINUS—THE DOLPHIN

Just to the left of Aquila, and a little lower in the sky is the small but ancient constellation Delphinus—the Dolphin.



DELPHINUS—THE DOLPHIN

Perhaps the chief interest in this constellation is the puzzle which at one time existed about the names of Nos 1 and 2.

They are called respectively Svalocin and Rotanev. One famous astronomer spent much time hunting through old Greek and Arabic manuscripts attempting to find the origin and meaning of these curious names Eventually he had to give it up, calling the first name "cacophanous and barbaric," and remarking of the second that it "putteth derivation and etymology at defiance"

The puzzle has, however, since been solved The names first appear in a catalogue issued from the Palermo Observatory The chief assistant at this observatory at the time was one by name Niccolo Cacciatore, or Nicholas the Hunter, which in Latin becomes Nicolaus Venator: now spell these two words backwards replacing the latin u by a v, and we have Svalocin Rotanev! Such was the method which this gentleman adopted to perpetuate his name and mystify others!

The star number 1 is a wide double, with a faint companion.

The star marked 3 is a beautiful and easy double. Both the components are fairly bright The principal star is of a yellowish colour, while its slightly less bright companion is bluish green in colour The relative movement of these stars round one another is very slow, and the time occupied by one in making a complete circuit of the other must be many centuries.

The four stars in the form of a diamond (including Nos. 1, 2 and 3 in the above map) mark the head of the Dolphin, while the isolated star away on the right marks the animal's tail There are two Greek legends involving Dolphins which are supposed to be the original of the Dolphin of the sky

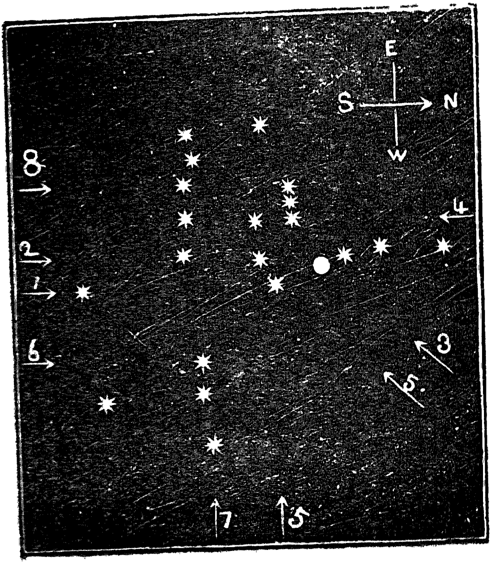
One legend states that the constellation represents the Dolphin which carried Amphitrite to be the bride of the sea-god Neptune, and no doubt it was as a reward for this good service that the Dolphin was given an immortal place among the stars of heaven

The other legend is this Arion, a poet and musician, had won some valuable prizes at a musical festival On his way home with his prizes, the sailors seized him with a view to murdering him and possessing themselves of his prizes. He asked, however, permission to play once more upon his cithara before he died Permission being granted, so beautifully did he play that a number of dolphins crowded round the ship to listen. Suddenly Arion threw himself overboard, and riding on the back of one of the dolphins was brought safely to land The Dolphin as a reward was placed amon the constellations.

HERCULES

We have already described the constellations Lyra a Boötes, marked by the bright stars Vega and Arctu respectively Early in the evening at this time of year Ve will be found high up in the east, Arcturus not quite so h in the west; later in the evening Vega will have passed zenith, and both stars may be found in the western sky.

Between these two conspicuous stars is the large cons lation Hercules, which will therefore be found directly ov head early in the evening or high up in the west later T principal stars of this large constellation are mapped below



HERCULES.

Although the constellation is such a large one, it contains no star of outstanding brilliancy, the brightest star is that numbered I, and is called Rasalgeti from the Arabic ras-al-jathi, the kneeler's head—Hercules being supposed to be kneeling, in fact the constellation is sometimes termed "the kneeler" This star is a most beautiful double star, one star being orange and the other emerald green, well worth examining through a telescope, the pair form a true double star and are moving under their mutual attractions The brighter star of the pair is also variable in its brightness, though not to a very large amount

Nos 2, 3 and 4 are stars whose distances have been measured No 3 is one of the nearest stars Its distance is such that light only takes eight years to travel from the star to the earth No 2 is about eight times as far away as 3, while 4 is about half the distance of No 2 These three stars are all of much the same brightness No 5 is a little brighter than 2, 3 and 4, and is noticeable as being a rapidly moving star It is moving towards the earth at the rate of 44 miles a second Capt Jacob, one of the most famous of Madras astronomers, thought more than half a century ago that he had determined the distance of this star, but it is now known that his results were invalid in this particular instance, probably on account of some slight errors of his instrument, which were not known to him at the time.

Nos. 6 and 7 are named Korneforos and Marsic, respectively. Nos. 2, 5 and 7 are all double stars. There is another double star in this constellation, which is not shown in the map, since the star is not a bright one, but it is nevertheless interesting on account of the changes in colour which have taken place in the stars As long ago as 1780 they were observed to be bluish white and white respectively. Later in 1824 they were bluish white and reddish, in 1830 and again in 1878 greenish yellow and reddish yellow, between these two dates in 1855 green and orange, while to-day they are both pale yellow

There is still one object of great interest in this constellation, which is marked in the map by a white dot between Nos 3 and 5. This is the great Cluster in Hercules. Here and there in the sky we find these clusters of stars, hundreds and thousands of stars all close together, sometimes with no regular outline, but more often with the appearance of being grouped according to some definite rule. In a great many cases the stars form a globular cluster and appear to us as a circular patch of stars, very dense in the centre and thinning out towards the edge Of such a type is this cluster, which is one of the few clusters visible to the naked eye. With a telescope it is a glorious sight In 1716 Halley described the Cluster as "but a little patch," yet within this "little patch" Sir William Herschel estimated there were 14,000 stars! Photographs have been taken, which show 5,500 stars, and doubtless longer exposures would show more stars.

Modern telescopes and particularly modern photographs of the stars have revealed many hundreds of these star clusters, both regular and irregular. In some cases a very large proportion of the stars in the cluster are found to be variable in brightness The elucidation of the many problems connected with star clusters is one of the most interesting branches of modern astronomy.

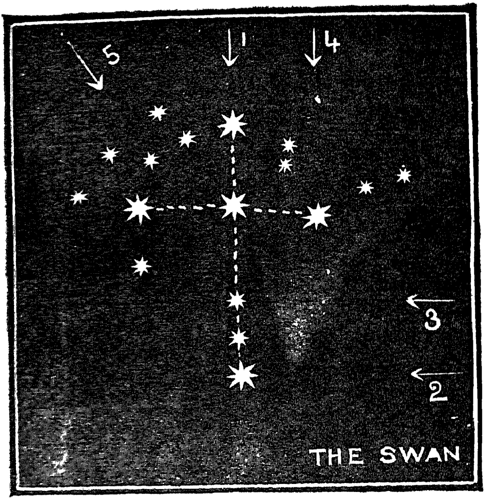
The Perseid meteors are most conspicuous during the second week in August, and should be looked for low down in the north. They are better seen in higher latitudes, since the part of the sky from which they radiate is below the horizon of Madras at this time of year in the early evening, though after midnight the constellation Perseus from which they come appears above the northern horizon. The best nights are about August 9 to 11, when the great Perseid shower is at its maximum

CYGNUS—THE SWAN.

On a fine night at this time of year, the eastern sky is a beautiful sight in the early evening.

Almost due east is the constellation Aquila, the Eagle, with the conspicuous bright star Altair, which we discussed recently. Nearly on a level with this constellation but to the left is the fine constellation Cygnus—the Swan, and running right across the eastern sky and through Cygnus is the Milky Way.

The Swan is a large constellation conspicuous even in the crowded region of the Milky Way in which it lies. It is figured below.



CYGNUS—THE SWAN

The principal stars form a fine cross, as shown by the dotted lines, a feature by which the constellation may be easily identified.

The star number 1 is called Arided or Deneb, the latter meaning tail The star is at a very great distance from the earth, and therefore since it shines as a bright star in spite of its great distance, it must in reality be an intensely luminous orb, outshining many times our own sun, Star number 2 is called Albireo It is a beautiful double star and may be seen as such in quite a small telescope the colours of the two stars are golden yellow and sapphire blue, and the pair forms perhaps the loveliest contrast of colours to be found in the heavens

During the 17th century five double stars were discovered, there having been no such discoveries previously. During the first half of the 18th century four more were discovered by Bradley, the famous English astronomer, and this star was one of them The brighter star of the pair is variable in brightness, though the variation seems to be quite irregular in character

The star marked 3 is as a rule quite invisible, since it is usually so faint as to require a powerful telescope to show it, but at certain times, at intervals of a little over 400 days, it becomes much brighter and is visible to the naked eye So great is the variation of brightness of this star, that at its maximum it gives about 3600 times as much light as at minimum!

The star marked 4 is a double star, but it requires a powerful telescope to separate the two stars.

The most interesting star in this constellation is, however, too faint to be detected with the naked eye. This is the star known as 61 Cygni.

To begin with, the star is a double star, and was another of the four stars discovered as such by Bradley prior to 1755. But historically the star is chiefly interesting as being the first star whose distance from the earth was measured. This result, which was announced in 1838, was pronounced by the great astronomer Sir John Herschel as the greatest triumph ever achieved by practical astronomy Even the nearest of the stars are so distant that the measurement of their distances is a matter of the utmost difficulty, and for many years baffled all attempts of astronomers, so that the measurement of the distance of 61 Cygni may well have been considered a great triumph, the more so as it was only the first of many such successful attempts to measure stellar distances.

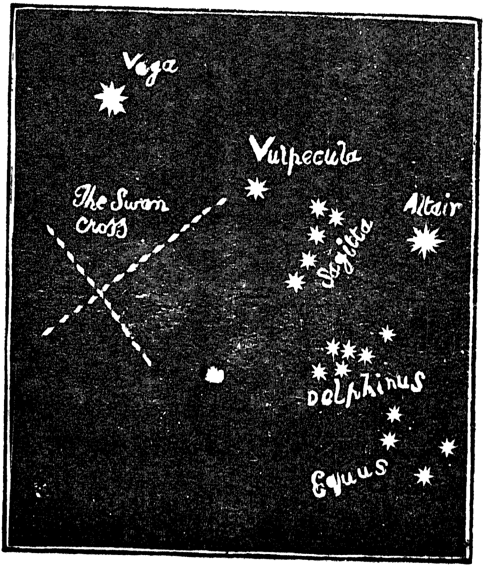
Later, when photography was applied to the problem of determining stellar distances, this same star, 61 Cygni, was the first star chosen for trial of the new method

There are only about half a dozen stars known to be nearer the earth than 61 Cygni It is a comparatively faint star. If it were placed at the same distance from the earth as the sun it would only appear about one-tenth as bright.

The star is one of the most rapidly moving stars known, and is moving through space at the rate of 51 miles a second.

VULPECULA, SAGITTA, AND EQUUS—THE FOX, THE ARROW AND THE HORSE.

Between the constellations Cygnus and Aquila are two small constellations, Vulpecula the little Fox, and Sagitta the Arrow. Just below these two is the Dolphin which we have already described, and just below this is another small constellation Equus—the Little Horse Above Cygnus and Vulpecula is the Lyre with the bright star Vega Later in the evening of course the positions are reversed, the constellations have passed over to the west, the Lyre is below the Swan, and the Dolphin is higher still



PART OF THE EASTERN SKY IN AUGUST.

The constellation Vulpecula is a very inconspicuous one, and only its brightest star is shown in the above map. This constellation is not an ancient one, having only been formed by Hevelius, some two and a half centuries ago It was originally called Vulpecula et Anser—the Fox and the Goose, but the latter part of the name has now dropped out of use Although containing nothing of much interest to the visual observer it contains several fine telescopic objects, including a nebula known from its shape as the dumb-bell nebula

The constellation Sagitta—the Arrow—on the other hand is one of the ancient forty-eight It consists in four or five stars in a straight line forming an arrow Several myths relate to it It has been regarded as the arrow of Cupid. Other writers have identified it with the arrow with which Apollo slew the Cyclopes for having provided Zeus with thunderbolts and lightning to kill Aesculapius, whose story was referred to in July when describing the constellation Ophiuchus Yet another tradition makes Sagitta one of the arrows with which Hercules killed the vulture which was gnawing the liver of Prometheus, who was bound to a rock on Mount Caucasus by order of Zeus Aratus describes the constellation thus —

> "There's further shot another arrow
> But this without a bow Towards it the Bird
> More northward flies"

Turning to Equus or Equuleus—the Little Horse—the stars, though small, are easily picked out since they lie well out of the Milky Way It is called the little horse to distinguish it from the large neighbouring constellation Pegasus —the Winged Horse—the mythic horse which sprang from the blood of Medusa—the Gorgon—slain by Perseus.

This is an ancient constellation and was formed by the great astronomer Hipparchus, who lived some two thousand years ago. Before his time these stars formed part of Delphinus—the Dolphin.

The four principal stars forming a trapezium are shown in the map on page 103.

The lower star of the pair on the left is a double star, but a large telescope is required to separate the components. They move round one another in a period of about five and three quarter years, an extremely short period for a double star. The two stars together are about twice as heavy as the sun. They are comparatively close to the earth Light which travels at the rate of one hundred and eighty-six thousand miles a second only takes forty-six years to travel from this pair to the earth. Readers of this book may marvel at the word only, but in spite of the enormous speed at which light travels it takes more than a hundred years to travel from most of the stars to the earth, so great is their distance, and even from the nearest of all the stars it takes over four years.

Another fainter star in Equus not shown in the map above is a triple star.

Equus is a small constellation and has consequently been rather neglected by poets, but we find a reference to it in Omar Khayyam in the words—

> "The flaming shoulders of the Foal of Heaven."

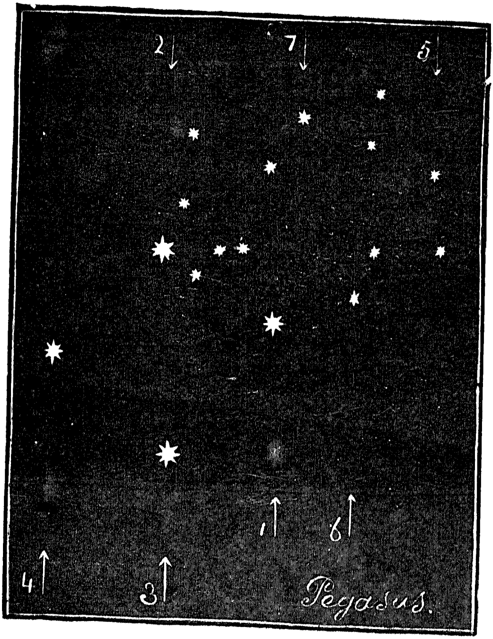
But Omar Khayyam was an astronomer as well as a poet, so it is not surprising that he knew the smaller constellations as well as the greater ones.

SEPTEMBER.

PEGASUS—THE WINGED HORSE.

In August I drew attention to a number of constellations n the eastern sky early in the evening This month, if you ill look east early in the evening low down, you will see the rge constellation Pegasus—the Winged Horse The onstellation is immediately below Cygnus—the Swan, but quite outside the Milky Way It is also a little below nd to the left of Equus the Horse, so that you should have o difficulty in finding the constellation

As one more means of identification, however, it may be entioned that the constellation is marked by a conspicuous uare of four bright stars.



PEGASUS—THE WINGED HORSE.

The four stars forming the square are marked 1, 2, 3, 4, in the above figure, but of these 4 no longer belongs to Pegasus, although formerly included in this constellation it is now included in the neighbouring constellation Andromeda.

There are a number of constellations in this part of the sky connected with the old mythological story of Perseus and Andromeda, but most of them are not yet visible. This constellation Pegasus is one of the group, Pegasus the Winged Horse being supposed to have sprung from the blood which dropped from the head of Medusa—the Gorgon—which Perseus slew.

To return to more astronomical matters. The star No 1 is called Markab, meaning a thing ridden on, perhaps in this case a saddle No 2 is called Scheat, No 3 Algenib, from the Arabic Jenab-al-faras, the horse's wing, No. 4 is called Alpherat, from Sirrat al-faras, the horse's navel, still retaining its old name though no longer included in the constellation No 5 is called either Enif or sometimes Fom, the first from the Arabic Emf the nose, the second from Fom al-faras, the horse's lip, while No 6 is called Homan from S'ad-al-homam, the hero's happy star of the Arabians.

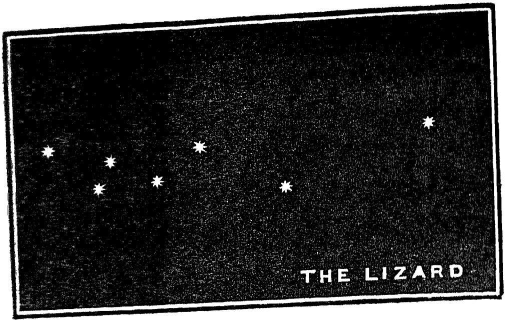
No 7 is a star well known to those astronomers who devote special attention to double stars. This particular star, however, is more than double. It is quadruple, and is designated by the Greek letter kappa, being known to astronomers as kappa Pegasi. The two closest stars of this pair move round one another very rapidly, completing a circuit in eleven and a half years (this may not appear very rapid, but when we remember that many double stars occupy more than a century in completing a revolution, and that many are much slower even than this, the comparative rapidity of the motion will be appreciated) These two stars require a very powerful telescope to separate them.

Another double star (it appears to be triple, but the third star does not really belong to the system) in this constellation is known as 85 Pegasi It consists of two stars, one of the sixth magnitude and the other of the eleventh. The fainter one, however, is more than half as heavy again as the brighter, and the two together are more than eleven times as massive as the sun Light takes about fifty-six years to travel from 85 Pegasi to the earth, and the two stars revolve around one another once in every twenty-four years

LACERTA—THE LIZARD

To the right of Pegasus is Aquarius, the Water-Bearer, the eleventh sign of the zodiac, to the left is the small modern constellation Lacerta the Lizard, chiefly notable for a new red star which appeared there a few years ago.

The constellation is figured below on a considerably larger scale than used in figuring Pegasus.



LACERTA—THE LIZARD

The two brighest stars are the two on the extreme left, but they are not very bright.

Lacerta is just below the left end of Cygnus (that is in the early part of the night, early in the month, before Cygnus has passed over to the west).

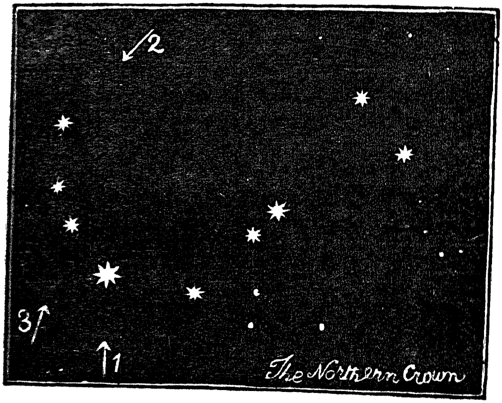
As we have mentioned the new star in Lacerta, we may here remark that it is due largely to the use of photography that there has been lately an increase in the number of new stars discovered; also no doubt it is partly due to the fact that there are far more people in these days than formerly who watch the skies with an intelligent interest, and who are sufficiently well acquainted with the stars to spot a newcomer at once. Indeed there is always a chance here for an amateur observer who does not even possess a telescope to make an important discovery. One such amateur has already discovered two new stars.

CORONA BOREALIS—THE NORTHERN CROWN.

We have already described most of the constellations which are visible in the western sky in the early part of the evening at this time of year.

High overhead, just a little to the north of the zenith, is the Lyre, marked by the conspicuous star Vega; below this is the large constellation Hercules, which fills a great deal of space but contains no star of outstanding brilliancy. Low down and almost due west is Bootes the Herdsman, easily picked out by the brilliant ruddy star Arcturus,—a constellation which was described in detail in June, while to the left of Bootes and a good deal lower is Virgo the Virgin, containing the conspicuous bright star Spica, but this must be looked for early, otherwise the constellation will have passed below the western horizon.

Between Boötes and Hercules is the constellation Corona Borealis—the Northern Crown. The chief stars form a crescent as shown in the figure.



CORONA BOREALIS—THE NORTHERN CROWN.

The brightest star in the constellation is that marked 1 in the figure, and is called Alphecca or Gemma, the latter word meaning jewel It is sometimes called the "Pearl of the Crown." It is a white star of about the second magnitude. It has a small and rather distant companion of a pale violet colour.

The star marked 3 is a well-known double star, and near it is a star sometimes termed "Variabilis Coronae," which cannot be seen by the naked eye, but which varies rapidly and in an irregular manner from the sixth to the thirteenth magnitude. Its variability was first noticed over a century ago in 1795.

Just near to the star marked *2* is a star known as T Coronae, which also is invisible without a telescope. Readers will remember the bright new star which appeared in the constellation Aquila—the Eagle—in June 1918. T Coronae was just such another

This star, however, was known before it appeared as a new star, which is not the case with most new stars. Prior to 1866 T Coronae was a comparatively faint star of magnitude about nine and a half On the night of May 12th, 1866, Schmidt at Athens was observing this constellation and saw nothing unusual in it, but only two and a half hours later in the same evening Mr. John Birmingham, an amateur astronomer, observing at Millbrook in Ireland found that this star, usually of magnitude nine and a half, had suddenly increased its light some two thousandfold and had become of the second magnitude and was plainly visible to the unaided eye. It at once began to fade, and after only eight days was no longer visible to the naked eye By the beginning of June it had reached its usual magnitude, and although at first it brightened up slightly once or twice, it ultimately settled down to its old state and has remained steady ever since, and may now be seen as a pale yellow star quite steady in its light. It was popularly termed the "Blaze Star" of the Northern Crown, and was the first new star to be observed with the spectroscope, with which instrument it was observed that the sudden extraordinary increase in the star's light was due to an atmosphere of blazing hydrogen.

This is the only new star which has ever appeared at any considerable distance from the Milky Way.

The Hebrews called this constellation Ataroth, while the Australian aboriginals called it Womera or the Boomerang.

It is supposed to represent the crown of seven stars presented by Bacchus to Ariadne, the daughter of Minos, King of Crete. The famous story of her love for Theseus who slew the Minotaur and subsequently deserted her is too well known to need description here It is well related in Kingsley's "Heroes" Students of Ovid will remember one of his odes in which Ariadne, deserted by Theseus, bewails her fate.

The constellation is an ancient one and is thus described by two ancient astronomer poets

Aratus describes the constellation thus .—

"There too that crown which Bacchus set on high
A brilliant monument of dead Ariadne."

While Manilius writes .—

"Near to Boötes the bright crown is viewed
And shines with stars of different magnitude;
One placed in front above the rest displays
A vigorous light, and darts surprising rays."

One end of the long winding and rather uninteresting Serpens lies just to the left of Corona Borealis. To the left of Hercules is Ophiuchus—the Serpent Bearer—and lower still just setting is the zodiacal constellation Libra—the Scales.

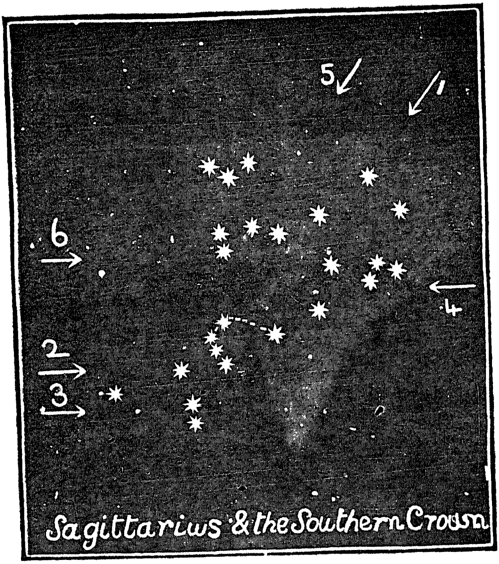
A magnificent portion of the Milky Way may now be seen stretching across the southern sky, which contains only one very bright star, *viz* Altair in the Eagle

SAGITTARIUS—THE ARCHER.

If you look south in the evening at this time of year you cannot fail to be struck with one particular patch of the southern sky, known as the great star cloud in Sagittarius. It lies just to the left of Scorpio, and on moonless nights looks like a continuous white patch in the sky. It is the richest portion of the whole celestial sphere and is crowded with thousands upon thousands of small stars.

This large constellation Sagittarius—the Archer in which this magnificent patch of sky lies is one of the signs of the zodiac.

The principal stars are shown in the map below, which also shows the small subsidiary constellation Corona Australis—the Southern Crown—which, of course, must not be confused with the other constellation, Corona Borealis—the Northern Crown.



SAGITTARIUS AND THE SOUTHERN CROWN.

The stars joined by a dotted line form the Southern Crown.

The star marked 1 is surrounded by an atmosphere of helium, and, unlike most similar stars, is in rapid motion, moving at the rate of 48 miles a second

The stars marked 2, 3, 4, 5, and 6, are called respectively Rukbat, Arkab, Alnasl, Nunki, Ascella—all Arabic names.

The constellation is generally represented in the form of a Centaur (that is a man's head and shoulders on the body of a horse) with a drawn bow and arrow pointed at the Scorpion.

Longfellow describes the constellation thus—

"The Centaur, Sagittarius, am I,
Born of Ixion's and the clouds' embrace
With sounding hoofs across the earth I fly,
A steed Thessalian with a human face"

The story of how he came into the zodiac is as follows ·—

The famous Centaur Chiron, son of Saturn and Philyra, was famous for his knowledge of medicine, music, and archery He taught medicine to Aesculapius, music to Apollo, and astronomy to Hercules

He was accidentally wounded by Hercules, with a poisoned arrow, but being immortal he could not die, and felt himself doomed to suffer great pain for ever He therefore prayed to Zeus to take away his immortality and allow him to die. Zeus did so, but by way of compensation placed him amongst the constellations, thus granting him immortality in another form. As Ovid says .—

"Midst golden stars he stands refulgent now,
And thrusts the Scorpion with his bended bow."

In Astrology Sagittarius is supposed to rule the fate of those born between November 22nd and December 21st, and any readers who happen to have been born between those dates will perhaps be pleased to hear it is a lucky sign. An old astrologer, who lived nearly four hundred years ago, says that those born under the influence of this sign will be married three times, be very fond of vegetables, will become very good tailors, and suffer three severe illnesses, of which the last, however, will not attack them till they attain the ripe age of eighty years Sagittarius contains some magnificent nebulæ and star clusters, and is well worth observing with a small telescope or a pair of binoculars

The sun is in this constellation from December 16 till January 18 , while in this constellation the sun is further south than at any other time of the year, and the earth is nearer to the sun than at any other season.

As already remarked just to the right of Sagittarius is Scorpio—the Scorpion

Above Sagittarius and a little to the left is Aquila—the Eagle—while above Scorpio is Ophiuchus—the Serpent Bearer.

Below Sagittarius is an unimportant modern constellation Telescopium, and just to the right of Telescopium is the small constellation Ara—the Altar

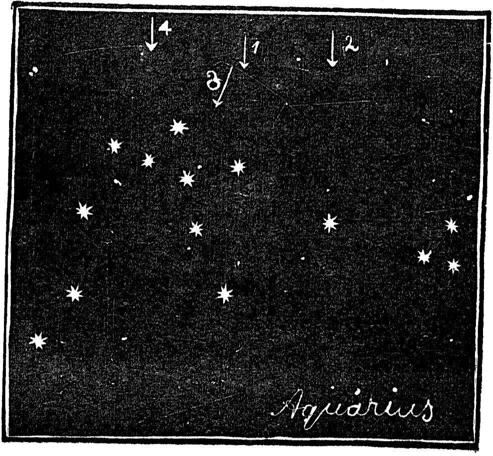
The Milky Way stretches across the southern sky from Aquila to Ara through parts of Sagittarius and Scorpio.

Photographs of this part of the Milky Way are so crowded with stars that it is impossible to distinguish individual stars They are packed so closely that they form one continuous patch of light, with here and there a curious dark patch suggesting the presence of some obscuring matter in places between us and the more distant stars blocking out their light.

AQUARIUS—THE WATER BEARER

At the beginning of this month, attention was drawn to the constellation Pegasus the Winged Horse, conspicuous by four bright stars forming a square In the third week, about ten o'clock at night, this constellation will be found almost immediately overhead, stretching both north and south of the zenith Just below this constellation in the south is the constellation Aquarius, the Water Bearer This is the eleventh sign of the Zodiac, and although it contains no stars of outstanding brilliancy, it contains a considerable number of stars visible to the naked eye, and situated as it is far from the Milky Way, these show up well.

The principal stars are figured in the map below.



AQUARIUS—THE WATER BEARER.

The star marked 1 is called Sad-al Melik, the King's lucky star No 2 is called Sad-al-Sud, and No 3 Gjenula

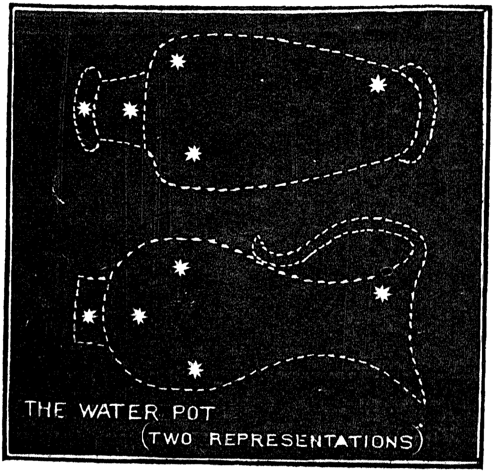
The constellation contains many interesting telescopic objects.

Several showers of meteors appear to come from points in this constellation, notably early in May, at the end of July, the beginning of August, and early in September.

The meteors visible from this constellation early in May are connected with Halley's comet, since they travel round the sun in the same orbit as this famous comet, an orbit which takes three quarters of a century to traverse These meteors (shooting stars is the more popular term) may well be little pieces of the comet, which have been dropped at different points of its path, and which continue to move round the sun on their own account A fine meteor belonging to this group was observed on May 5, 1915 It was seen to traverse a path of eighty miles in length at a height of over sixty miles above the earth, and with a speed of forty miles a second!

I am not quite sure just how this group of stars was supposed by the ancients to represent a man carrying water. One authority supposes that the top five stars in the map above (those numbered 1, 3 and 4, and the other two near them) formed the water pot, while the man had to be fitted somehow into the remaining stars. At present it would seem difficult to fit a man into this group unless he were lying down, but a few thousand years ago, when the constellation was formed, the left-hand side of the group would be much higher than the right, and it may then have seemed possible to the ancients to fit in a man in a reasonable position for carrying a pot of water formed by the five stars mentioned.

I give below two possible representations of the water pot on the assumption that these five stars form its outline, according as the mouth of the pot is supposed to be to the right or left

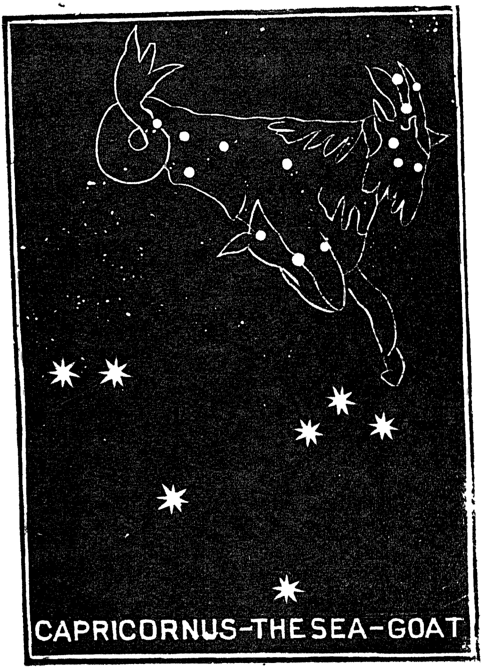


TWO REPRESENTATIONS OF THE WATER POT.

CAPRICORNUS—THE SEA GOAT.

The bright star immediately beneath the left-hand portion of the constellation Sagittarius is Fomalhaut, the brightest star in the Southern Fish. Below the right hand portion of Sagittarius is the constellation Capricornus the Sea Goat, the tenth sign of the Zodiac.

The principal stars of this constellation are figured below.



CAPRICORNUS—THE SEA GOAT

The two stars at the top right-hand in the map are the two components of a wide double, and may be seen as separate stars with the naked eye. Each of these stars is itself double, but it requires a good telescope to separate them. The two principal stars are known as Prima and Secunda Gieda, from Al-jedi—the Goat.

It will be noticed that all the constellations in this part of the sky are connected with water,—Aquarius, the Water Bearer, Capricornus, the Sea-Goat, Pisces, the Fishes, Piscis Australis, the Southern Fish, Cetus, the Whale, Eridanus, the River Po.

It was a superstition amongst the ancients that when all the planets (by which they meant the Sun, Moon, Mercury, Venus, Mars, Jupiter, and Saturn, for they did not know of Uranus and Neptune, but on the other hand they considered the Sun and Moon as planets) came together in the constellation Capricornus, there would be a deluge.

In the same way they held that when all the planets came together in the constellation Cancer, the Crab, then the world would be destroyed by fire These beliefs are very old, and are said to date back to the ancient Chaldeans, who claimed to have observed the stars for 470,000 years, and to have calculated the nativity of all the children who had been born during this time, but this was evidently only a legend.

Those who picture the constellations usually represent the Sea-Goat as a fish-tailed goat with the head and horns where the stars on the right are in the above map, the forefeet in the middle and with his tail flourishing off towards the stars on the left on the map

The exact origin of the name sea-goat is not very certain In this connection the following lines may be quoted ,—

A startling monster's hybrid form
Your eyes will there assail
That sign so often dubbed the Goat,
Yet with a fish's tail

This constellation is very ancient, being found in Babylonian inscriptions more than three thousand years old.

OCTOBER.

CEPHEUS.

Lately we have been considering some southern constellations. Let us turn now to the northern sky.

If we suppose the time to be about nine o'clock at night near the beginning of this month, we shall see Cygnus the Swan high overhead. Below to the left is Draco the Dragon, forming a great curve of stars enclosing Ursa Minor, the Lesser Bear, which is almost horizontal, the two bright stars called the Guardians of the Pole being on the left, and the Pole Star itself is of course due north, and terminates the constellation on the right.

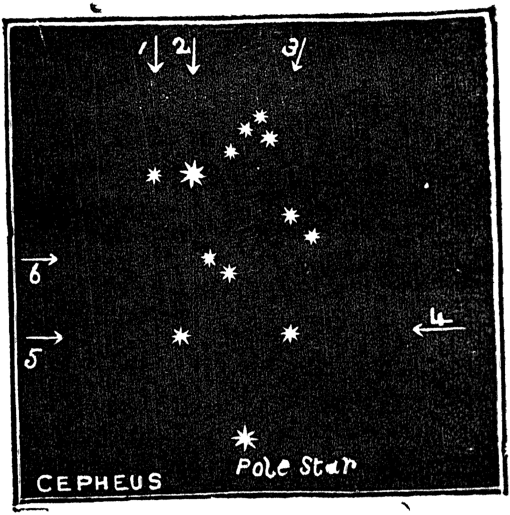
Just right of the Swan is the little constellation Lacerta —the Lizard—which we figured in September.

Below the Swan and the Lizard, and between them and the Pole Star, is the constellation Cepheus, representing the father of Andromeda, another of the constellations connected with the story of Perseus To the right of Cepheus and a little higher up is Cassiopeia, which represents his wife.

Below Cassiopeia on the right of the Pole Star is a large blank space, entirely devoid of bright stars. The faint stars in this region have been combined into a modern constellation, Camelopardus, the Giraffe.

The constellation Cepheus is largely involved in branch of the Milky Way The chief stars are figured bel the Pole Star being included as an aid to identificat although it does not belong to this constellation.

The three brightest stars in the constellation are ma 2, 6 and 4 in the map No 2 marks the king's right shou and is called Alderamin, a corruption of an Arabian na which means the right arm. No. 6 lies in the king's gi and is called Alphirk, while No. 4 is called Alrai.



CEPHEUS.

The star marked 1 is in rapid motion, moving at th of over fifty miles a second, No. 2. Alderamin, will be the north Pole Star some five thousand six hundred years hence.

No. 6 is a fine double, observable in a small telescope, the two components being yellowish white and blue

The stars 5 and 3 are also double, 3 being an easy object in a small telescope yellow with a small blue companion.

No. 3 is also a variable star At its brightest it gives nearly two and a half times as much light as when it is at its minimum, its period of variation being five days, eight hours, and forty-seven minutes.

It takes about twice as long to fall from its maximum to its minimum as it does to rise again from minimum to maximum This star is typical of a large class of variable stars known as Cepheid variables

This constellation contains many variable stars

There is a variable star just above the star shown on the right of No 2 in the map above. It varies from the fourth to the sixth magnitude in irregular periods. It is extremely red in colour and was called the "Garnet Star" by Sir William Herschel. It is a fine sight in a pair of field glasses.

The positions of the neighbouring constellations with respect to Cepheus and the manner in which the various stars form the figure are concisely described in the following doggerel lines —

Near to his wife and daughter see
Aloft where Cepheus shines,
That wife, the Little Bear, and Swan,
With Draco bound his lines,
Beneath the Pole Star twelve degrees
Two stars your eye will greet—
Gamma, the nomad shepherd's gem,
And Kappa mark his feet

Alphirk, the Hindu's Kalpeny,
Points out the monarch's waist,
While Alderamin, beaming bright,
Is on the shoulder placed,
And where, o'er regions rich and vast,
The Milky Way is led,
Three stars, of magnitude the fourth,
Adorn the Aethiop's head

The wife and daughter referred to in the first line are the neighbouring constellations Cassiopeia and Andromeda, while Gamma and Kappa in the last two lines of the first stanza are the Greek letters used by astronomers to designate the stars marked 4 and 5 in the above map.

It will be seen that the second stanza tallies with the description given above. The reference to the Aethiop in the last line is due to the fact that Cepheus was supposed to be an Ethiopian. He has even been identified with Cheops, the builder of the Great Pyramid He was also one of the Argonauts who sailed under Jason to Colchis to gain the Golden Fleece

The fifth line of the first stanza is scarcely applicable to the constellation just now, since at this time of year the two stars (Gamma and Kappa) referred to are above the pole not below it, but in northern climes six months from now, the constellation will be seen upside down below the pole, and this description will be strictly applicable

I mentioned that the old name of the Pole Star was Cynosura, and so Aratus, the astronomer poet of 2200 years ago, so often quoted in these notes, writes —

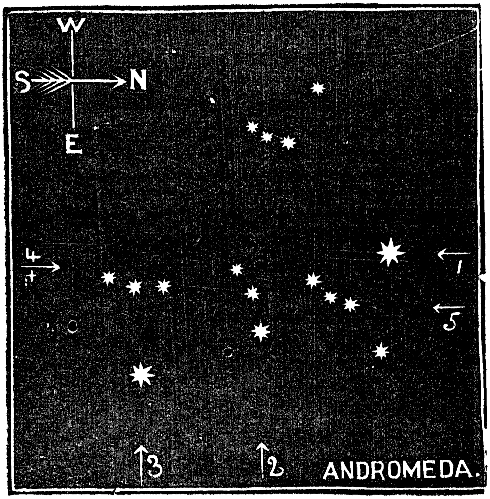
> Cepheus himself just behind Cynosura
> Stands like one spreading both his arms abroad

The star Gamma, No 4 above, marks the radiant point of a meteor display visible annually towards the end of June, though the meteors which appear to radiate from this star (of course they really have no connection with the star itself) are not usually very bright or conspicuous ones

ANDROMEDA

About nine o'clock at night in October the constellation Pegasus is overhead Below Pegasus and to the east of it is the constellation Andromeda You will therefore find this constellation by looking high up in the eastern sky It is a large constellation, and most of the constellation lies rather to your left as you face east. As we mentioned before when describing Pegasus, the chief star of the constellation Andromeda is one of the four bright stars forming the great square of Pegasus hence there should be no difficulty in finding the constellation Near to Andromeda are the constellations representing Cepheus and Cassiopeia, her father and mother, and that representing Perseus, her lover.

The constellation is figured below



ANDROMEDA

The three brightest stars are those marked 1, 2, 3, called respectively Alpherat, Mirach, and Almaach These three stars form a slightly curved line.

No. 3 is a very beautiful triple star, though only a very large telescope will show it as such. Smaller telescopes show it only as a double star, of which the brighter is golden yellow, the other sea-green in colour

But by far the most famous and most striking object in this constellation is the Great Nebula, the first known nebula, and the finest object of its kind in the sky.

So large and bright is this object that it quite fills the field of even a small telescope, and with a large telescope it is only possible to look at a very small portion at a time, while on clear moonless nights it is just visible to the naked eye.

It lies just west of the star marked 4 in the map. When Andromeda is in the east, as it is now early in the evening, 4 is the top of a vertical line of three stars, of which the lower is the bright star no. *2* referred to above. The Great Nebula lies just above the uppermost of these three stars.

In shape the nebula appears as a long oval, although this is probably due to the fact that it is viewed obliquely: in actual fact it is probably circular in shape. It is not uniformly bright, its brightest portion is in the centre, and the bright parts of the nebula form a spiral curve This is in fact the finest of the very numerous class of spiral nebulae.

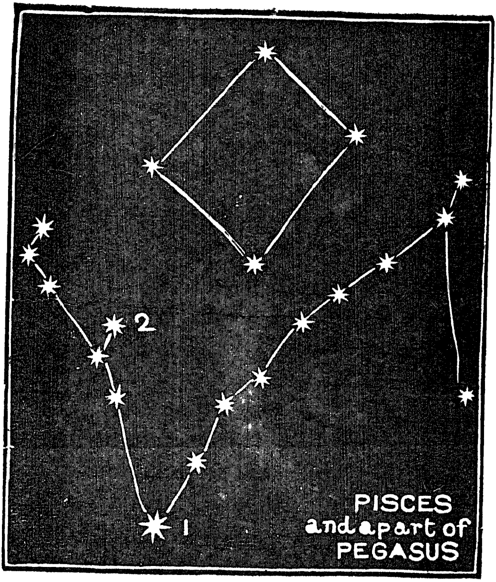
We have referred once or twice to Novae or New Stars. One such appeared in this Great Nebula in August 1885. Like other objects of this class, it blazed up very suddenly in a position in which no star had ever been seen before, and then its brightness fell off rapidly, though not nearly so rapidly as it had blazed up; by March 1886 it had become so faint that even with the largest telescope it could not be seen The star marked 6 in the map is in rapid motion, moving at a rate of over fifty miles a second

There are many interesting telescopic objects in this constellation, including double stars, and also several small nebulæ, besides the one already referred to, which is always known as the 'Great Nebula in Andromeda." So conspicuous is it indeed that it was known to the Arabs many centuries ago, and may well have been known to even earlier nations, though previous to the invention of the telescope no one can have had any idea of the true glory and splendour of this magnificent object, perhaps the finest object for a small telescope in the whole sky

PISCES—THE FISHES.

Although the constellation Pisces, the Fishes, contains no bright stars, it is a very large one It is in the east in the early evening at this time of year. Its shape is that of a great straggling V, with the brightest star of the constellation at the bottom of the V, and the four bright stars forming the Great Square of Pegasus between the two arms of the V. To aid in identifying the constellation I have shown these four stars in the map.

Andromeda occupies a position just over the left arm of the V formed by Pisces.



PISCES AND A PART OF PEGASUS

Pisces is the twelfth sign of the zodiac, described in the well-known lines as "the fish with glitt'ring tails" They are usually represented as two fishes far apart connected by ribbons knotted together at the star marked 1 in the above map This star marked 1 is the brightest in the constellation and is called Okda from the Arabic Okdah-al-Khaitain, meaning the knot of the two threads It is also called Alrischa.

This star is a double, visible with a moderate telescope. The principal star is pale green and the other blue in colour.

The star marked 2 is also a fairly easy double, both components being white in colour

Aratus describes the constellation very aptly as usual thus —

> The Fishes float, one ever uppermost.
> Both are united by a band
> Their tails point to an angle,
> Filled by a single goodly star

The following is the ancient legend as to how the Fishes got into the sky :—

There is another constellation called Piscis Australis—the Southern Fish This Southern Fish was the parent of the two Fishes represented by Pisces , when the giant Typhon attacked the gods on the bank of the Euphrates, Venus transformed herself and her son Cupid into fishes to escape from the giant's fury. In memory of this event Minerva placed these two fishes in the sky.

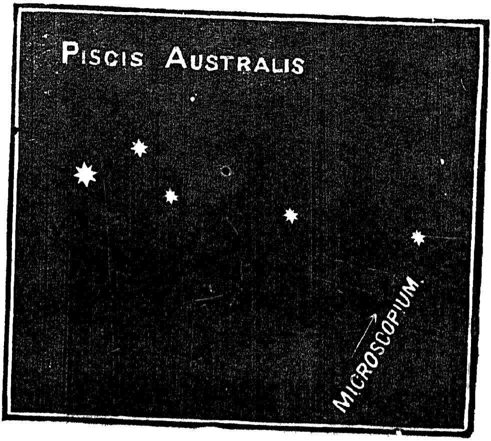
Astrologically Pisces is the ruling sign for those born between February 19 and March 20 and is considered unfortunate.

[I mention this because some of my readers may be interested in astrology, not because I have the slightest belief in it myself.]

PISCIS AUSTRALIS—THE SOUTHERN FISH.

We have described the constellations Capricornus the Sea Goat and Aquarius the Water Bearer, which between them occupy a goodly portion of the southern sky in the evenings at this time of year The part of the southern sky which lies to the north of these two constellations is occupied by Pegasus, the Winged Horse The chief constellation visible below the two zodiacal constellations is Piscis Australis, the Southern Fish, which may be easily identified by the bright star Fomalhaut, the only bright star in the southern sky at this time Below Piscis Australis is Grus, the Crane, a small constellation containing some fairly bright stars The other constellations in this part of the sky are nsignificant modern ones

Piscis Australis is figured below The map also shows he principal star of one of these minor constellations, Microscopium, the Microscope, which is close to the Southern Fish



PISCIS AUSTRALIS—THE SOUTHERN FISH.

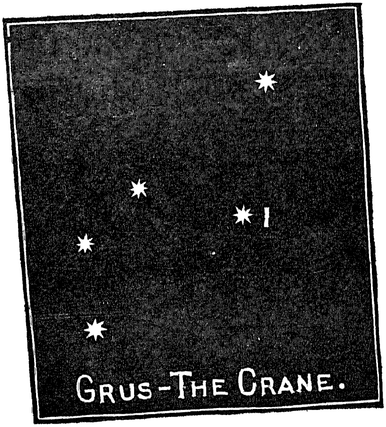
The bright star on the left is Fomalhaut, the eighteenth brightest star in the sky. Its apparent brightness is largely due to its comparative closeness to the earth. Light takes the moderately short time of 25 years to travel from Fomalhaut to the earth.

Owing, too, to its nearness to the solar system, it appears to have a fairly rapid movement across the sky, although it is not in actual fact among the most rapid of stellar travellers in space.

GRUS—THE CRANE

Below Fomalhaut and the Southern Fish is the constellation Grus—the Crane. It contains some bright stars, which show up well on a dark background of sky.

This is not a very ancient constellation, it is too far south to have attracted the attention of the ancient Greeks. It was added to the list of constellations by Bayer early in the 17th century A.D. The constellation is figured below.



GRUS—THE CRANE.

All the stars shown are fairly bright, the star marked 1 being the brightest The distance of this star from the earth is known Light travelling at the rate of 186,000 miles a second takes just about two hundred years to travel from this star to the earth, so that the distance of this star is very great Its distance being known, its rate of motion and its brightness can be calculated It is moving across the sky at the rate of forty miles a second, but in spite of this great speed, owing to its great distance, it appears stationary to the ordinary observer, and it is only when refined calculations are carried out that the actual motion of the star can be detected. The star is really a very bright one, but appears only of the 2nd magnitude on account of its great distance Were it placed at the same distance from the earth as the sun it would give six hundred times as much light as our sun does, so that the glare which we experience in the middle of the day in India would be darkness compared to the noon-day brilliance of such a sun

When describing some southern constellations in February, I explained that those surrounding the South Pole are of much later origin than the ancient 48 constellations contained in Ptolemy's Star Catalogue

For a long time it has been a moot point who originally formed these southern stars into constellation groups The honour has been attributed in turn to nearly every nation whose navigators early visited the southern hemisphere, Portuguese, Spanish, Dutch, etc

The constellation Crux, the Southern Cross, was known as early as 1519 A. D, when we find it mentioned by

Pigafetta in his journal of Magellan's Voyage, but it was not till nearly a century later, about 1592, that all the bright southern stars were grouped into constellations The first map of these southern stars was published in 1592 Only one copy of this map is now known, and that is at Valencia in Spain A second edition, of which several copies are known, was issued two years later The first catalogue of southern stars was published by Frederick de Houtman, a Dutchman, in 1608, as an appendix to his Vocabulary of Malay and Madagascan words This also is very rare, only four copies being known This contains 196 stars not previously catalogued, divided among 20 constellations, the numbers ranging from one star added to Crux to 34 stars in Argo Frederick de Houtman claims to have observed these stars himself, but it appears very improbable that he did so. In the voyages he made to Madagascar and Malay he went as a trader, and not as a seaman, and was probably fully occupied with his commercial duties most of the time, nor was he well versed in methods of observation then in use Most of the time he was in Sumatra on the second voyage he was a prisoner, and therefore not likely to have much chance of making observations.

On the other hand Pieter Dirckez Keyser, another Dutchman, who accompanied Houtman as navigator, was well versed in mathematics and astronomy. As a navigator he was specially interested in cataloguing the southern stars for the use of sailors, and moreover during the long stay which his ship made at Madagascar, as a navigator he would be comparatively idle, and would have time for this work, while Houtman would be busily engaged in commerce and in collecting materials for his Madagascan dictionary

Unfortunately Keyser died before returning to Holland, and there seems little doubt that Houtman took advantage of this fact to appropriate his results and publish them as if they were his own observations

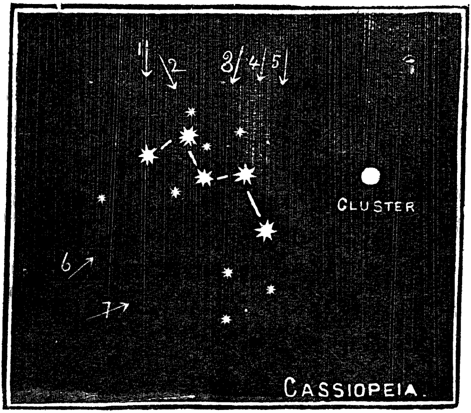
In any case it seems to be definitely settled now that the southern stars were first assigned to constellations and definitely catalogued in the last decade of the sixteenth century by a Dutchman, and that Dutchman was in all probability Pieter Dirckez Keyser, and not Frederick de Houtman

It may be added that bearing in mind the instruments which were available in those days the observations are surprisingly accurate, which is further evidence that they were the work of a skilled observer rather than of an amateur who was fully occupied with other duties and could have spared but little time for the work

NOVEMBER.

CASSIOPEIA.

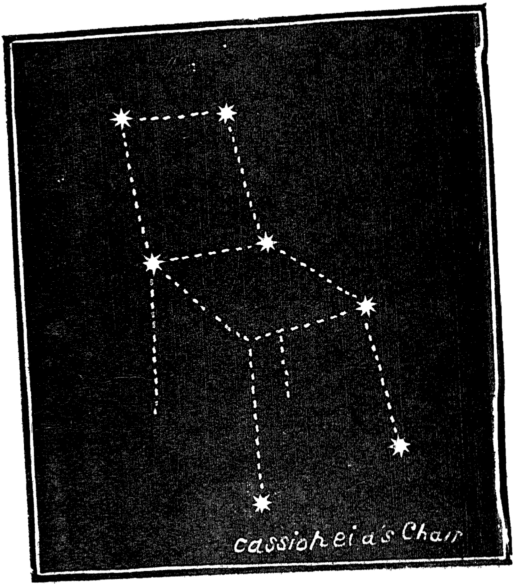
If you look due north about 9 p m in November you will see well up in the sky and a little to your right five bright stars forming a conspicuous letter W (or M, according to the way you look at it) These are the principal stars of the constellation Cassiopeia, which is figured below



CASSIOPEIA

Cassiopeia is nearly the last of the constellations connected with the old Greek story of Perseus, which we have to describe Above Cassiopeia is Andromeda, her daughter To the left and somewhat lower down is Cepheus, her husband, and to her right is Perseus, Andromeda's lover

Cassiopeia is always represented in a chair, **formed by the stars** marked 1, 2, 3, 4, 5, 6, and 7 in the figure, and for this reason the constellation is sometimes known as the Lady in the Throne, or the Lady in the Chair.



CASSIOPEIA'S CHAIR.

The star marked 1 is called Caph and that marked 2 is named Schedir

The little star lying between 2 and 3 is of some interest. It is a double star, the colours of the two stars being pale yellow and reddish purple Either star moves round the other once every one hundred and ninety-six years. The distance between them is fifty-three times as great as the distance of the earth from the sun, or about five thousand million miles ! The larger star is nearly three times as heavy as the sun, while the smaller is only just slightly heavier than the sun

There are three stars in this constellation whose distances from the earth are known, the star we have just been discussing, that marked 2 in the map, and a faint star not shown in the map

This latter faint star is noteworthy as being one of the most rapidly moving stars known It is moving through space with the enormous speed of one hundred and thirteen miles a second, about seven thousand times as fast as a train travelling at sixty miles an hour

A new star was discovered in this constellation in 1572 by the famous Danish astronomer Tycho Brahe It blazed up suddenly in the beginning of November, 1572, and was soon brighter than Venus, brighter in fact than any other star, temporary or permanent Those with good eyesight could see it at midday even, and it shone through clouds which were sufficient to obscure all other stars in the sky

The star may still be seen with a large telescope, shining as a very faint star many million times less bright than in 1572.

Its colour was at first dazzlingly white , it then turned reddish, and afterwards took on a livid hue It remained at its brightest for only about three weeks before beginning to fade rapidly.

At the point in the map marked Cluster, is a very fine cluster of stars, which however really lies in the constellation Perseus The two stars 3 and 4 point to this cluster, which can be seen on clear moonless nights as a dim hazy patch in the sky With a powerful telescope, however, one can see in the little tiny patch of sky more stars than can be seen with the naked eye in the whole sky It is well worth looking at with a small telescope or a good pair of binoculars

This is perhaps an appropriate place to outline very briefly the story of Perseus which is pictorially represented in the part of the sky in which Cassiopeia lies

Neptune, the old sea god, was angry with Cassiopeia, the wife of Cepheus, because she had boasted that she was fairer than Juno and the Nereids, and in order to avert his wrath her daughter, Andromeda, was bound to a rock by the seashore to be devoured by a great sea monster

Meanwhile the hero Perseus flying through the air on his winged horse, with the Gorgon's head which he had cut off, beheld Andromeda chained to the rock Discovering her intended fate, he awaited the coming of the sea monster, to whom he showed the Gorgon's head, and thus changed the monster into a great rock. Perseus then released Andromeda, and married her.

This is the old Greek heroic myth, the chief actors in which have been perpetuated in the heavens Cepheus, Cassiopeia, Perseus, Andromeda, all are there, so too is Pegasus the Winged Horse, supposed to have sprung from the Gorgon's blood, and Cetus the Whale may be taken to represent the great sea monster

Cassiopeia lies within the Milky Way, but below Cassiopeia and to the right of the Pole is a great blank space containing no bright stars and only one unimportant constellation

All the constellations now visible in the western sky have already been described, but in every case when they were in the east, and consequently the maps will have to be turned upside down to fit the constellations in their present positions

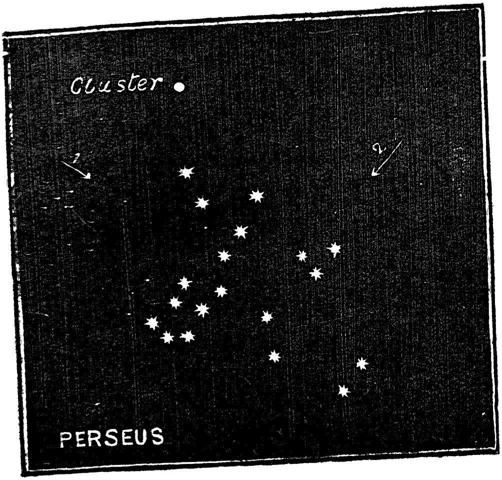
The two bright stars visible in the west are Vega in the Lyre on the right and Altair in the Eagle on the left Above the Lyre is the Swan, between the Swan and the Eagle are the little Fox and the Arrow Above the Eagle is the Dolphin, above that the Small Horse, and higher still, Pegasus

Below the Lyre and rather to the right of it is the large constellation Hercules

Close to the horizon can be seen parts of the constellations Serpens the Serpent and Ophiuchus the Serpent-bearer, constellations which contain no specially bright star.

PERSEUS

The constellation Perseus, like Cassiopeia, lies right in the Milky Way. In November it will be found high up in the north-eastern sky, just below Cassiopeia and Andromeda It is figured below



PERSEUS.

The stars marked 1 and 2 are called respectively Mirfak and Algol The latter name is supposed to be a corruption of Alghul, meaning the demon.

Algol is the most interesting object in this constellation. It is the most famous of a class of stars known as Algol variables, the name of the class being derived from this typical star

This star shines most of the time as a second magnitude star. At stated intervals, however, it begins to fade, and in the space of three-and-a-half hours it fades to the fourth magnitude, that is to say, it only shines with one-sixth the light it usually gives. It then remains faint for about twenty minutes, and then in three-and-a-half hours it brightens again, till it is once more of the second magnitude, at which it remains for two days and thirteen hours, when it again begins to fade and the same behaviour is repeated.

The regularity of these changes was first discovered by John Goodricke in 1783, though the fact that the star was variable in its light was known more than a hundred years before, and may even have been known to some of the ancients.

The explanation of this variation in light, which occurs with never-failing regularity, and can be predicted to the minute, is now well ascertained It is as follows —

Algol is really a double star, but one of the stars is dark, so that we cannot see it This dark star moves round the other bright star, just as the earth goes round the sun, and once in every revolution the dark star passes in front of the bright star and eclipses it Being smaller than the bright star it does not completely eclipse it, but it blocks out five-sixths of the light. When the dark star begins to come in front of the bright star the light begins to get less It continues to do so till the dark star is completely in front of the other, which takes three and-a-half hours It continues in front for about twenty minutes, and then begins to pass away from the bright star, and the light begins to increase till after three-and-a-half hours the dark star is quite clear of the bright, and the latter shines with undiminished glory.

In such a case as this it is possible to calculate both the sizes and masses of the two stars, with the following results '— the diameter of the bright star is over one million miles, that of the dark star about 800,000 miles The distance between the the centres of the two stars is about three-and a-quarter million miles. The bright star moves with a velocity of about twenty-six miles a second, and the other at a speed of about fifty five miles a second The bright star is twice as heavy as the dark one, but the two together are only two-thirds as heavy as the sun

The fine cluster of stars already referred to, and shown in the map of Cassiopeia, is also shown in this map

It is from a point in this constellation that the meteors or shooting stars known as the Perseids appear to come They are visible in the latter half of July and the first half of August, every year.

Writing of shooting stars reminds one that November is one of the best months in the year for observing meteors On any clear night during this month one is sure to be able to see many meteors

There is one special shower connected with this month, known as the Leonids, because they appear to come from a point in the constellation Leo In 1799, 1833, and 1866 wonderful displays of these meteors were seen, in each case on November 13th. In 1866 as many as 8000 meteors were observed at Greenwich

In each case too there were rich displays of meteors on the same night for a year or two previous and a few years subsequently. It was confidently expected that there would be a recurrence of the display in 1899, but only a few Leonids were seen Something must have occurred to divert the main mass of the Leonids from their usual path

However, one can always see a few Leonids about November 13th, given fine weather, and there are also plenty of other meteors about this time of year Anyone who watches the sky for an hour or two, especially on a moonless night, is pretty certain to be rewarded with the sight of a few meteors.

ARIES AND TRIANGULUM—THE RAM AND THE TRIANGLE

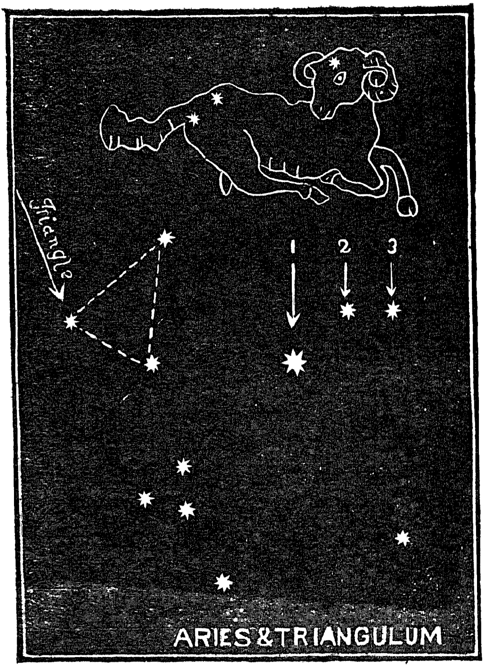
I suppose many of my readers know the old doggerel lines which serve as an aid in remembering the names of the signs of the zodiac, and the order in which the sun passes through them, but for the benefit of any who may not be familiar with them we may perhaps be excused for quoting them They run as follows —

The Ram, the Bull, the heavenly Twins,
And next the Crab the Lion shines,
    The Virgin and the Scales,
The Scorpion, Archer, and Sea-Goat,
The Man that holds the water pot,
    And Fish with glittering tails

One has rather to neglect the ordinary rules of pronunciation at the end of the fifth line, but the lines are certainly a useful aid to the memory

It is to the first of these constellations, the Ram, that I wish now to draw attention

If you look due east early in the evening at this time of year, you will see low down a bright ruddy star   This is Aldebaran, the brightest star in the constellation Taurus the Bull   A little higher is the small group of stars called the Pleiades, probably well known to most readers   Higher still and just a little to the right of Aldebaran and the Pleiades is the constellation Aries   Above Aries is the constellation Triangulum, the Triangle,



ARIES AND TRIANGULUM.

The three stars at the top which I have connected in the diagram by dotted lines form the Triangle, one of the ancient forty-eight constellations The remaining stars belong to Aries, which of course being one of the signs of the Zodiac is an ancient constellation.

The position of this constellation relative to the next sign of the Zodiac, the Bull, is referred to by an old Latin poet Manilius, as follows —

> First Aries, glorious in his golden wool
> Looks back, and wonders at the mighty Bull

The small group of three stars on the left of the above diagram, and immediately below the Triangle, at one time formed a separate constellation called Musca the Fly

The three stars numbered 1, 2, and 3 form the Ram's head, and are called respectively Hamal, the Arabic for a sheep, Sheratan, and Mesarthim

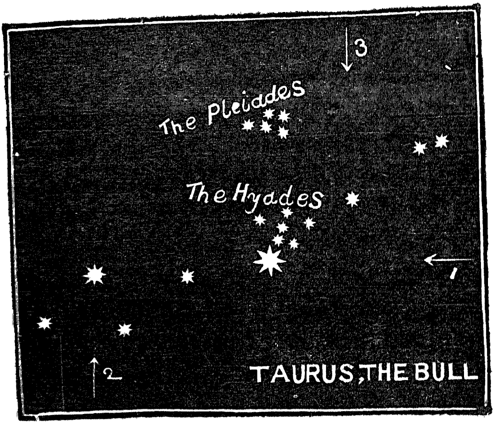
No. 3 is a double star, one of the earliest double stars discovered. Robert Hooke discovered it to be double on February 8th, 1665, when a bright comet happened to pass near this star It forms a beautiful object for a small telescope, the two stars being of the same colour and almost exactly the same brightness They both move through space together in the same direction and at the same rate, but relatively to one another their motion is very slow. Since they were first discovered they have scarcely shown any relative motion, nevertheless the fact of their common motion through space proves that they are a true pair, and in course of time one star must circle completely round the other, though that time may be thousands or even tens of thousands of years.

This motion of one star of the pair round the other is a necessary consequence of the laws of gravitational motion, which, though their effects may appear slow, are exceedingly sure.

TAURUS—THE BULL

If you will look east about 8 p m any night in November, you will see a number of constellations which I have already described High overhead is Andromeda, below Andromeda is Aries, to the left of Andromeda is Cassiopeia, below Cassiopeia is Perseus, and lower still is Auriga the Charioteer, containing the conspicuous bright star Capella, a constellation which has yet to be described in this book

The constellation Taurus, the second sign of the Zodiac, is below Aries, almost due east, and is easily identified by the bright red star Aldebaran, and the well-known star-group the Pleiades. I give below a map showing the principal stars



TAURUS—THE BULL.

The bright star marked 1 above is Aldebaran It is a conspicuously red star The name signifies the hindmost, and is said to be due to the fact that this star follows on behind the two star groups of the Pleiades and the Hyades

The next brightest star in the constellation is that marked 2, which is named Nath, from the Arabic Al-natih, the butting, because it forms the tip of one of the bull's horns, the star below 2 and a little to its right forms the tip of the other horn, and close to this star is a nebula known as the "Crab" Nebula, but it requires a good telescope.

Aldebaran is the fourteenth brightest star in the sky It is a double star, but only the bright star is visible either to the naked eye or with a small telescope, the other star being very faint indeed Aldebaran is one of the stars whose distance from the earth is known. It is a comparatively near star, but is nevertheless so distant that it is difficult to convey an adequate idea of this distance Falling back on the usual method we can say that light travelling at the rate of 186,000 miles a second takes nearly thirty years to travel from Aldebaran to the earth!

The star marked 3 is an eclipsing star, like Algol in the constellation Perseus It consists of two stars moving round one another in a period of three days and twenty three hours. One of the pair is only faintly luminous, and when it passes in front of the brighter star, the latter is partially eclipsed and appears much less bright

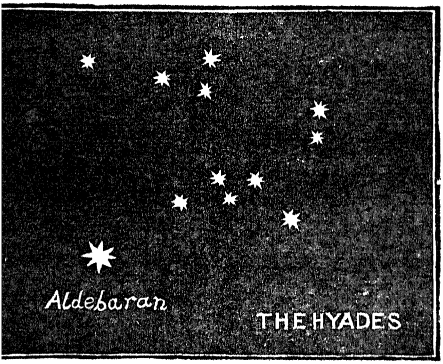
There is another Bull in the sky, the constellation Taurus Poniatowski, Poniatowski's Bull, a small constellation inserted in the sky by Poczobut in 1777 The constellation is in the west at this time of year, on the borders of Hercules It is small and unimportant

To the right of Taurus is the constellation Eridanus, the River, containing the fine bright star Achernar Below Taurus are the constellations Gemini the Twins, the next sign of the Zodiac, and the great constellation Orion, the finest constellation in the sky, which we described in January, and saw setting in the west in April This constellation is now visible above the eastern horizon about 9 p m, and Orion's belt points almost directly down to Sirius, the brightest star in the sky.

The constellation Taurus is famous because of the two notable star-groups which it contains, the Pleiades and the Hyades The latter is a well known group, though more open and scattered than the Pleiades The name signifies rain, these stars being supposed in olden times to have a rainy influence. Aldebaran belongs to this group.

I give here a map of the brighter individual stars belonging to this group, on a larger scale than the map of the

Taurus The group is worth looking at through glasses or a small telescope, though not so fine ne Pleiades. I have only shown the more tars.



THE HYADES

dinary eye six stars are visible in the Pleiades, tionally keen sight can make out more than six, irteen having been seen by one or two with it

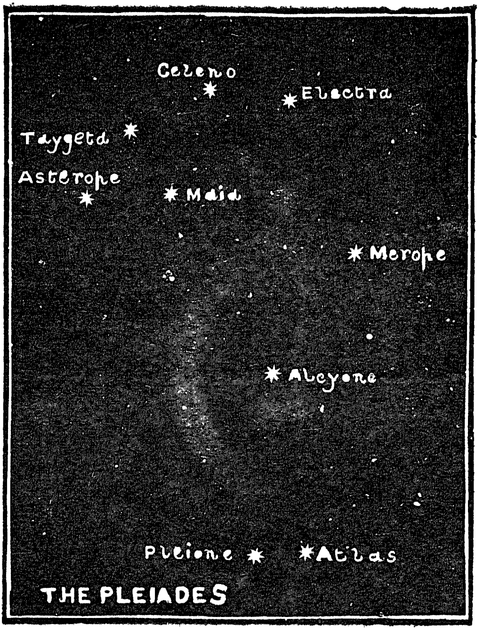
a well-founded ancient tradition that formerly ere easily visible, from which we are led to ne star formerly visible has lost some of its l is no longer visible to the naked eye.

There are numerous references to this famous group of stars both in ancient and modern literature They are mentioned three times in the Bible (Job IX 9, XXXVIII 31, 32, Amos V 8), and also in Homer and other ancient writers

This group is intimately associated with many forms of religion as practised by primitive peoples There exist to-day ancient stone monuments oriented so as to point to the Pleiades when rising or setting The 17th November, the day when they pass the meridian at midnight, was the signal at Busiris for the beginning of the Feast of Isis, while on this day no petition was vainly presented to the ancient kings of Persia The aborigines of Australia dance to their honour, and in fact in all parts of the world we find ancient traditions and religious rites connected with this group of stars.

Besides the stars visible to the naked eye, even a small telescope reveals many others, while the application of photography increases the number enormously, over two thousand stars having been photographed in this little group

In the map below are shown only the nine brightest stars, all of which have names which I have inserted in the map. A great many more are visible with a good pair of glasses or a small telescope.



THE PLEIADES

Of course, looked at with an inverting telescope, the above map must be turned upside down

The following is the order of brightness, beginning with the brightest —Alcyone, Electra, Atlas, Maia, Merope, Taygeta, Celeno, Asterope, Pleione, the last three being all about the same magnitude.

This group of stars is not a mere accidental group They form a real physical group, all probably having a common origin, and all moving at the same speed in the same direction

Their distance is very great. They are probably at such a distance that light, fast as it travels, takes about 200 years to traverse the distance between the Pleiades and the earth they may be even further away than this

Were our sun placed among the Pleiades it would be quite invisible to the naked eye, and even with a telescope would appear quite insignificant Some fifty or sixty of the Pleiades would look brighter

The distance of the outer stars of the group from Alcyone must be about fifteen billion miles, perhaps even more, more than 150,000 times the distance between the earth and the sun Even at such a distance, Alcyone would appear sixty times as bright as does Sirius to us who dwell on the earth, and Sirius is to us the brightest of all the stars.

Yet bright as Alcyone is, and far as she would outshine our sun if viewed from the same distance, nevertheless on the confines of the Pleiad group, Alcyone would be no compensation for the loss of our sun Many hundreds of thousands of stars equal to Alcyone would be needed to give at that great distance light equal to that which the sun sheds upon the earth

The fact is, so vast is the scale on which this group is composed that it is difficult to find any analogy which can convey an adequate conception of these distances to any earth dweller, and yet, as we have stated above, the whole group is bound together by invisible forces and is steadily pursuing its way through space.

The group contains many double stars Maia is a double star, but too close a pair to be separated even in the largest telescope nevertheless spectroscopic observations have proved it to be double without doubt

The whole of this vast group is wrapped in a nebulous cloud of matter With the largest telescope faint traces of this can be seen. With a long exposure on a photographic plate, the whole becomes visible, a vast cloud of nebulous matter glowing with an extremely faint light and enshrouding all the Pleiads

As I write, there lies before me a chart on which are mapped 2326 stars of this group, together with the more conspicuous parts of the nebulous matter intermixed with them

What a wonderful group is this little band of stars, conspicuous in ancient religious rites, known throughout history, oft quoted in literature, named the Pleiades!

DECEMBER.

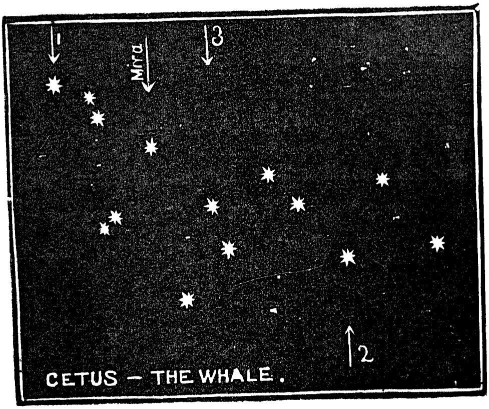
CETUS—THE WHALE.

If you look south about 8 o'clock at night in December, the skies in this direction will appear somewhat unfamiliar to you, supposing your knowledge of the constellations has been entirely gleaned from the foregoing pages Since we last looked at the southern part of the heavens, many fresh constellations have come into view

You will see Aries the Ram, recently described, high up in the sky To the left is the constellation Taurus the Bull, which with its included star-group the Pleiades occupied our attention in November

To the right of Aries and somewhat lower down is the constellation of Pisces the Fishes , below Pisces and Aries is Cetus the Whale , below and somewhat to the left of Cetus is the great constellation Eridanus, occupying a large space and terminating at its southern end in the bright star Achernar , to the right of the star Achernar and a little above it is the constellation Phœnix It is the constellation Cetus the Whale which I want to figure and describe now. At the beginning of this month it will be found at the time mentioned due south, immediately over the bright star Achernar, and a good deal higher in the sky.

It is a large constellation and occupies a good deal of space It is figured below



CETUS—THE WHALE

Since the ancients who originated the forms of the constellations can scarcely have been acquainted with whales, it is possible that this constellation was intended to represent some mythical sea-monster, very likely that connected with the story of Perseus and Andromeda, and it is only in modern times that the constellation has become identified with an actual monster of the deep

As regards the somewhat unwieldy and curious shape of this constellation, an astronomer once slightly modified certain of Shakespeare's lines as follows.—

It's almost in shape of a crocodile.
By the mass, and 'tis a crocodile indeed.

Methinks it's like a weasel
It is backed like a weasel
Or like a whale?
Very like a whale

The star marked 1 is called Menkab from the Arabic Minklui, meaning the nose or snout No 2 is called Diphda, from Difda al Thani, meaning the second frog, the Arabians calling the bright star Fomalhaut in the Southern Fish Difda al Awwel, the first frog No 3 was called Batn Kaitos, the belly of Cetus, by the Arabian astronomers

To one star in the map I have attached the word Mira, the Latin for wonderful This star is known as Mira Ceti the wonderful star in Cetus

The extraordinary behaviour of this star was first noted in the 16th century, and in the 17th century its character was fully established as what is known as a long-period variable It however derives distinction from the fact that it is the most famous and in some ways the most extraordinary of the several hundred long-period variables known

A star whose light is not constant in intensity is called a variable star If, as usually happens, it varies in a definite manner, being at its brightest after certain definite intervals, which change but little or not at all, it is a periodic variable if that period is long, say a year in length, the star is classed as a long-period variable Such is Mira Ceti The period of Mira Ceti is about eleven months—331 days At its faintest it is quite invisible to the naked eye, being below the ninth magnitude, while at its brightest it reaches the second or third magnitude, and is therefore at such times conspicuously visible to the naked eye. It is this great range in brightness that makes the star so extraordinary At its brightest it emits 1500 times as much light as it does when faint!

And yet, although for three hundred years these periodic conflagrations have been observed, the star shows no sign of losing its energy, and regularly flares up and appears to our vision as a bright star.

Its actual brightness at the maximum varies, but it generally is at least of the third magnitude, and sometimes fully of the second magnitude It remains at its brightest for only two or three weeks, and then begins to fade again.

This star is a fairly rapid traveller through space, though its exact rate cannot be given in miles per second, since its distance is unknown

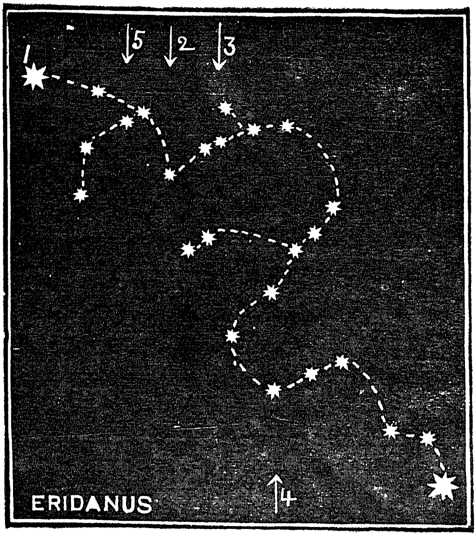
Note —In speaking of the magnitudes of stars, we always mean their apparent magnitudes as seen from the earth The brightest stars are said to be of the first magnitude, the next brightest class of the second magnitude, and so on

ERIDANUS—THE RIVER.

Eridanus the River is one of the largest constellations in the sky, and winds about much as a river does over a very wide tract of sky

The most noteworthy object in this constellation is the bright star Achernar, the tenth brightest star in the sky, which you will see low down, near the horizon, and nearly due south in the early evening

This star is the southern end of the constellation, and is just below Cetus The second brightest star in the constellation is at its other extremity and lies close to Rigel, the bright star at the south-west of the constellation Orion. These two bright stars are connected by a long winding course of lesser stars, as in the figure below, in which I have connected the stars by a dotted line to show the likeness to a great river with here and there a small tributary stream joining it.



ERIDANUS.

The big star at the bottom of the map is Achernar If this star were at the same distance from the earth as is the sun, it would appear twenty-eight times as bright

The star marked 1 is, as already mentioned, close to the much brighter star Rigel This star is called Cursa from the Arabic Al-kursa, a chair or throne No 2 is called Zaurak from the Arabic Neyyir-al-Zaurak, meaning bright star of the boat

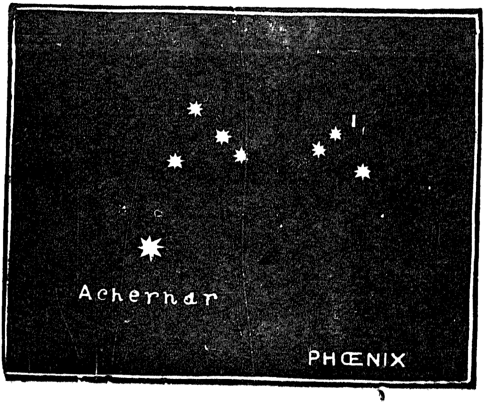
Nos 3 and 4 are both very rapidly moving stars, the latter having slightly the greater apparent motion Both of them are within the first twenty stars in order of rapidity of motion 3 is considerably further away, 4 is moving through space with a speed of something over sixty miles a second.

No 5 is another very rapidly moving star, moving even faster than either of those just mentioned Its actual velocity in space is over 70 miles a second, and it is a little nearer to to us than either of the stars just mentioned This star is the principal member of a system of three stars, all physically connected, pursuing their journey through space in the same direction and all having the same enormous velocity The other two members of this system are at a great distance from this principal star, equivalent to about five hundred times the distance between the earth and the sun (which distance is itself about 93 million miles) This pair of stars is quite faint and invisible to the naked eye Besides moving rapidly through space they are also in mutual revolution, the one revolving about the other once in 180 years, the average distance between the pair being about 38 times the distance between the earth and the sun, The two of them taken together are rather more than one and a half times as heavy as the sun, the fainter of the two stars being slightly heavier than the other, but they are neither of them nearly as bright as the sun These three stars move over a space of sky nearly equal to one quarter of the moon's diameter every century, and they are at such a distance that light takes twenty years to travel from them to the earth, so that they rank as comparatively near stars Nos 4 and 5 were among the very earliest stars whose distances were determined

Above the eastern portion of Eridanus are Aries and Taurus, and on its eastern side are the constellations Orion and Lepus

PHŒNIX

Close to Achernar in the river Eridanus, which we have just described, is the small constellation Phœnix This is figured below, and Achernar is also shown in the map, though it must be remembered that Achernar does not belong to Phœnix but to Eridanus



PHŒNIX.

The constellation is not a very conspicuous one, though it contains a fair number of stars visible to the naked eye It only dates from the beginning of the seventeenth century. The only star of any special interest in the constellation is that marked 1, which is the brightest star in the constellation, and is moving very rapidly through space at the rate of over fifty miles a second

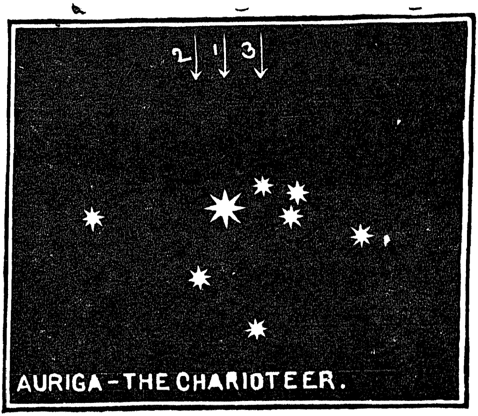
It will be noticed that between Phœnix and the lower part of Eridanus and Cetus there is a large blank space This space is quite devoid of bright stars, and was left by the ancients bare of any constellation More modern writers have put in two quite inconspicuous constellations—Fornax and Sculptor—to fill in this space

AURIGA—THE CHARIOTEER

If you will look to the north-east early any evening this month, and look high up in the sky, you will see a very bright star This star is considerably to the left of the Pleiades and somewhat higher up This star is Capella, the fifth brightest star in the sky and second only to Vega among the stars in the northern hemisphere of the sky Capella is the principal star of the constellation Auriga, the Charioteer, one of the ancient forty-eight constellations

Early in the evening Auriga is just below Perseus, a constellation which has already been described A little later in the evening, however, the two constellations will be found to be at about equal altitudes, nearly due north, Auriga being to the right of Perseus. Like Perseus, Auriga lies almost wholly in the Milky Way.

The constellation is figured below.



AURIGA—THE CHARIOTEER.

The bright star marked 1 is Capella; the star marked 2 is called Menkalinan.

It is possible that Capella has changed colour during historic times, as the ancients described it as red, whereas now it is slightly yellowish white.

It is a star which in some respects closely resembles our own sun, being composed of much the same gases and metallic vapours. It is a double star, the two stars mutually revolving in a period of 104 days They are too close to be seen separate in any ordinary telescope. The double character of the star was first detected with a spectroscope.

The actual rate at which the stars revolve is at least seventy miles a second

The two stars together are probably several times heavier than our sun, and they are 100 times as bright, and possibly hotter in proportion

The distance of Capella is such that light takes forty years to travel from Capella to the earth

The pair is moving away from the sun at the rate of twenty-one miles a second in addition to their joint motion of revolution round one another.

The star marked 2 is also what is known as a spectroscopic binary, that is to say, a double star, which, however, cannot be seen as such with any telescope and whose duplicity is only determined by means of the spectroscope This pair consists of two bright stars mutually revolving in a period of four days at a rate of at least 150 miles a second

The two stars together are not less than five times as heavy as the sun

Yet another bright star in this constellation is a spectroscopic binary, *viz*., that numbered 3 in the map.

The relative velocity of the components of this star is about twenty-five miles a second But this star is not only a spectroscopic binary, it is also a variable star, which is remarkable from the fact that if the period of variation assigned to it is correct, *viz* , a little over twenty-seven years, this star has the longest definitely known period of variation.

The variation is not very great, decline and recovery of light together last thirteen or fourteen months, in between is a period of ten months during which the light is at minimum, while for the remaining twenty-five years or so of the period the star remains constant at its maximum brightness The last minimum of this star occurred in 1901-1902, so that at present it is shining uniformly with its maximum light, and the next variation may be expected in 1928

This constellation also contains a number of beautiful star clusters and other interesting telescopic objects

Now that we have described Auriga we have dealt with all the most important constellations in the heavens

At present in the early evening the situation of the constellations in the northern sky is as follows —

The Pole star itself is, as always, due north, and the Little Bear stretches below it down to the horizon To the left is Cepheus, on a level with the Pole Above Cepheus, is Cassiopeia, and Perseus is higher still To the right of Perseus and above Cassiopeia is Andromeda. To the north-east and high up is Auriga, below Auriga is the Great Bear stretching right down to the horizon, and (early in the evening) below the horizon The great constellation Draco—the Dragon—is at present underneath the Pole and invisible in these latitudes during the early hours of the night.

In the south, as we have seen, Cetus, Eridanus, and Phœnix, are now the chief constellations visible, In the west, the bright stars Altair and Vega are low down, particularly the former, but Cygnus is still a fine sight with its cross of bright stars Pegasus and Andromeda are the other principal constellations in this part of the sky.

But the eastern sky during this month is the finest part of the heavens in the early evenings Those who have followed these notes from the beginning (now nearly a year ago) will recognize the constellations coming up in the east as old friends,—Orion the Hunter, with his two dogs, Canis Major and Minor, and the two zodiacal constellations Taurus the Bull and Gemini the Twins Of bright stars there are a great number,—Sirius, the brightest in the whole sky, Procyon, Capella, Aldebaran, Betelgeuse, Rigel, Castor and Pollux, and a host of others, all conspicuously bright The famous star group, the Pleiades, and the Hyades cluster, are both well placed for observation in the east, while low down on the left the Praesepe or Beehive cluster is coming into view. The great nebula in Orion can just be seen with the naked eye The Milky Way stretches right across from south-east to north-west passing a little north of the zenith.

> "The sad and solemn night
> Hath yet her multitude of cheerful fires,
> The glorious host of light
> Walk the dark hemisphere till she retires.
> All through her silent watches, gliding slow,
> Her constellations come and climb the heavens and go"

BRYANT.

MAPPING THE STARS.

It is well known that the number of stars which can be seen with the naked eye, even on a clear moonless night, is only a small fraction of the number revealed by a large telescope But even the telescope has its limits, and there exists a vast stellar world beyond the range of any telescope, while others are only just within the reach of the largest telescopes But the invention of the gelatine dry plate has put into the hands of the astronomer an instrument far more powerful than the largest telescope Stars which would require an enormously powerful telescope to reveal them to sight can be photographed with comparative ease, and to-day there is scarcely an important branch of astronomy in which photographic methods have not superseded the older visual observations

No sooner was the power of the photographic plate to record images of faint stars discovered, than a scheme was organized for a survey of the stellar universe on a scale never previously attempted. In 1887 an International Conference of astronomers met in Paris, and decided to photograph all stars down to the twelfth magnitude, and to use these photographs as the basis of an accurate catalogue of the positions of these stars in the sky Such a scheme, involving the determination of the positions of some four or five million stars, was far beyond the resources of any one observatory, and the work was consequently divided into portions and allotted to some 18 or 19 observatories scattered over the two hemispheres. One of these portions eventually came to be allotted to the Nizamiah Observatory, Hyderabad, and the first photograph for the Hyderabad zones was taken in December 1914.

The photographic plates are specially manufactured for the purpose, being far more rapid than those usually obtainable, they are 16 centimetres (about 6½ inches) square, and are made of plate glass to ensure a plane surface

The camera used is about eleven feet long with a lens eight inches in diameter, it is, in fact, a telescope, but instead of putting an eye to the lower end the photographic plate is placed there, and the images of the stars impress themselves on the plate during the exposure. The length of the exposure given at Hyderabad varies from twelve minutes to twenty minutes, according to the rapidity of the plates Owing to the earth's rotation, the image of the star would move right across the plate in about eight minutes, and it is therefore necessary to move the telescope round by clockwork to counteract the earth's rotation, so that the images of the stars remain steady and a good photograph results In order to ensure the accuracy of this motion, a second telescope is fixed to the photographic telescope with a lens ten inches in diameter, and through this an observer watches a star throughout the exposure. If the image does not remain absolutely steady, by pressing an electric button he can at once correct the clockwork After the exposure is given, the telescope is slightly moved, and a second exposure (generally half the length of the first) is given, so that each star is represented by two little black spots close together on the plate This means, therefore, that an observer often has to watch a star steadily through the telescope for 30 minutes without a break, a very trying and tedious job As any number from six to a dozen plates may be taken in one night, and between each plate the clockwork has to be wound up and the dome of the telescope house turned round, an astronomer's life is not altogether devoid of hardships !

The plate is developed in the ordinary way, but before doing so a network of small squares, 676 squares on each plate, is printed on it for use in the subsequent measurement. No print is taken from the plate, but the black dots on the negative itself are measured, the plate being viewed through a small microscope for this purpose. Each star is measured at least twice to prevent mistakes The distances of each star from the sides of the square in which it happens to lie are measured, and from these measurements, after correction, the actual position of the star in the sky can be calculated by means of certain formulæ

Eeach plate shows several hundred stars, on the average about 350 The actual numbers vary from 120 to 1600 at Hyderabad.

In addition to determining the positions of the stars, a determination of the brightness of each star is made at the same time A bright star will make a large black image on the photograph, while a faint star will produce only a small grey image. hence by measuring the size and blackness of the star images we can determine the brightness (or magnitude, as it is termed) of each star.

When the Hyderabad work is finished, 720 photographs, containing in all about a quarter of a million stars, will have been taken and measured As the measurement etc , of each star involves the use of more than 40 figures, the total number of figures used in the course of the work runs into millions In spite of the fact that the quantity of the work to be done is so great, the accuracy is considerable Each measure is correct to about one-hundredth part of a millimetre, and the final star place is determined to within less than half-a-second of arc that is to say, the error in the position of the star is about as big as a silver two-anna piece would look 2½ miles away

The utility of the work is already assured, for the volumes of similar catalogues which have already been issued by some of the other participating observatories (such as Greenwich, Oxford, Paris, Perth, etc) are in almost daily use in most of the great observatories of the world, while from the Hyderabad work it has already been found possible to draw important conclusions as to the distribution of the stars in various parts of the sky The full fruits of the work, however, will only appear in future years, when by comparison with other observations we can determine the movements of the stars (for the so-called fixed stars are very far from being fixed) Before the advent of photography we knew nothing of the fainter stars, which today are as readily accessible to us as the brightest gems of the sky Whereas in the old days we could only observe a few stars every night, we can now photograph thousands in a night, and these can be measured at any time and with great rapidity. **An** experienced measurer can measure upwards of an hundred stars per hour.

It will thus be seen that in one of the most gigantic schemes for scientific co-operation ever inaugurated, H. E. H. the Nizam's Government are bearing a not unimportant part, and whatever may happen to the Nizamiah Observatory in future, the Hyderabad Astrographic Catalogue will remain a lasting memorial to the Observatory, and perhaps a not unworthy contribution on the part of India to this great work.

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